CONDITION ASSESSMENT MANUAL
for Building Component-Sections

For Use with

BUILDER™ Version 3 series
and
BUILDER RED Version 3 series

D.R. Uzarski, Ph.D., P.E.
M.N. Grussing

June 7, 2006

U.S. Army Engineer Research and Development Center
Construction Engineering Research Laboratory
Champaign, Illinois 61826

Table of Contents

1. OVERVIEW

INTRODUCTION

This manual describes the procedures for performing Condition Survey Inspections for building related component infrastructure using the BUILDER^{TM} Engineered Management System (EMS). These condition surveys are not detailed engineering assessments, preventive maintenance inspections, or specialized inspections, but they do satisfy the requirements necessary for routine building facility management activities including long range budgeting and sustainment / restoration / modernization (SRM) planning. This building assessment process provides an objective and generalized framework to help to identify problem areas that will require more investigation through detailed or specialized assessments. There may be times when detailed engineering assessments may be required to diagnose specific problems.

The condition survey inspection directly supports the computation of a condition index metric for a building component-section, known as the Component-Section Condition Index (CSCI). Prior to the condition survey inspection, a building component inventory model is created which describes the systems, components, and individual equipment or material items that make up the building. Each component is further defined by one or more "component-sections" based on the presence of different materials or component types. For example, the Exterior Wall component may be wood, masonry, or another material, each of which would constitute a separate section. Component-sections may also be defined based on physical building location. An example is Interior Ceiling component, which may be defined as a component-section for each floor of the building, even if the ceiling type and material is identical. Finally, a component-section may be defined based on components of different ages or installed at significantly different times. For more information about the BUILDER inventory process, refer to the "BUILDER Inventory Manual" which includes thorough discussion of sectioning philosophy. For the purposed of a condition survey inspection, it is important to understand the concept of component-sections, since the condition assessment process is conducted at the component-section level. The component-section is the "management unit" upon which asset management decisions are made, and the CSCI is the fundamental index metric in BUILDER.

As the fundamental condition metric for building assets, the CSCI is aggregated using a bottom-up approach to determine a Building Component Condition Index (BCCI), a System Condition Index (SCI), and a Building Condition Index (BCI). This hierarchy is illustrated in Figure 1. Likewise, the BCIs can be average or aggregated for groups of buildings, complexes, or entire installations (or portfolios) to represent an overall condition indicator. BUILDER contains the programmed algorithms to compute the CSCI metric and all higher corresponding CI metrics from the condition survey data that is entered. BUILDER also allows for separate assessment of component-section coating condition by the Coating Condition Index (CCI), which is based on the work by Marshall, et al.

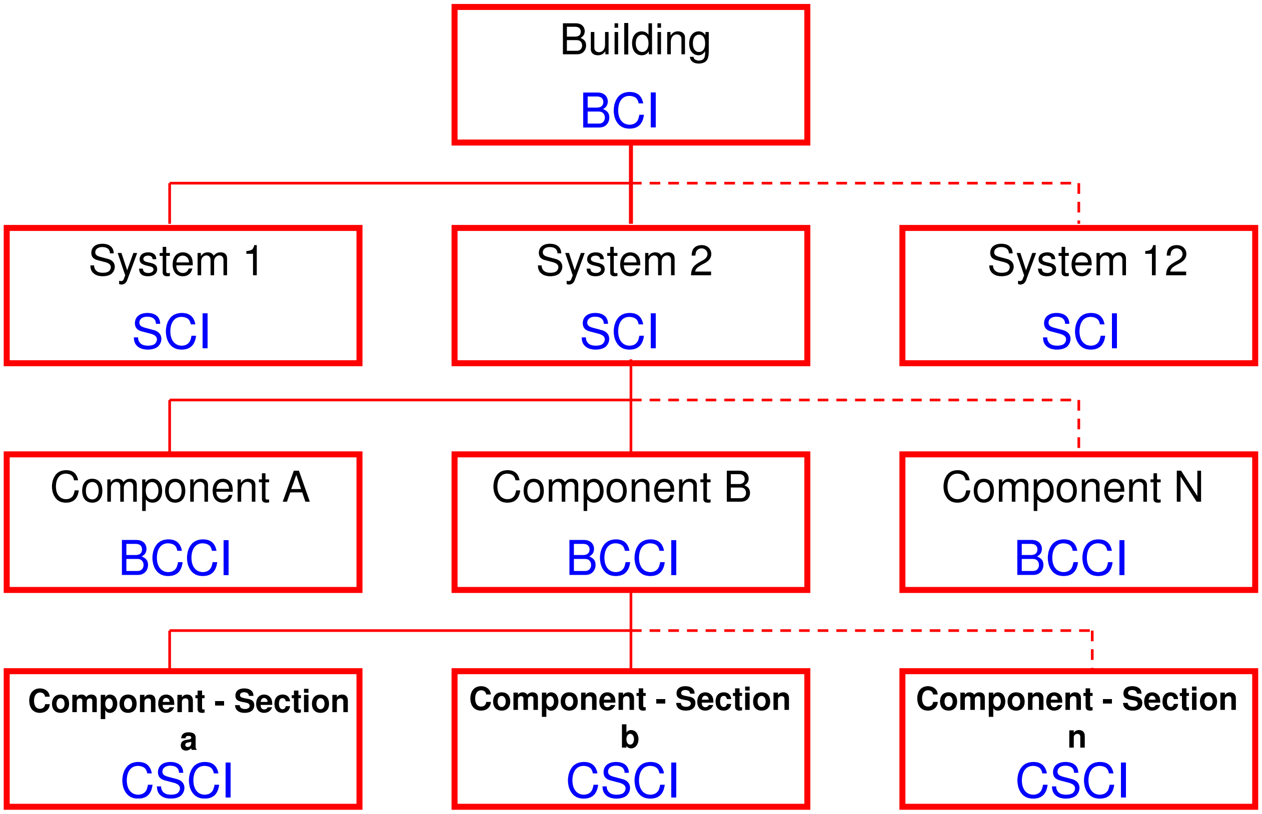

Figure 1. Condition Index Hierarchy

Each component-section within a given building has its own particular condition life cycle trend. Each has a finite service life at the end of which replacement (or major restoration) is required. Also, most component-sections have a maintenance window where repair work actions can be performed to correct accumulated degradation and restore some lost condition. The difference between the current age and expected service life is the remaining service life (RSL). The difference between the current age and some scheduled beneficial maintenance / repair action is the remaining maintenance life (RML).

BUILDER has default expected service life values for all component-sections listed in the system inventory catalog. These values are a compilation derived from several sources, and serve as an initial gross estimate. In reality, the actual values can have a wide range due the multitude of variables that affect how long something will last. One of the reasons for performing a condition assessment is to establish and calibrate the predicted condition index vs. age curve as illustrated in Figure 2. From this, the RML and the RSL can be more accurately estimated. In BUILDER, the default service life values serve as an initial “seeding” of the prediction models and give a reasonable estimate of life. As condition data are added over time, the service life information are automatically adjusted in BUILDER to give better estimates as to when a specific component-section is expected to fail and must be replaced or rehabilitated.

The most efficient point in the life cycle when corrective action should be performed is rarely near or after the failure state has occurred. In this context, corrective action is a broad term that encompasses maintenance and/or repair work associated with reducing or eliminating the distresses (cracks, deterioration, damage, etc.) negatively affecting a component-section. As these distresses accumulate, the component-section approaches what is referred to as the "sweet spot" (see Figure 2) for maintenance and repair. The theoretical sweet spot is a narrow range of CSCI values that represent the economically optimum condition where maintenance/repair work should be performed. Performing maintenance work while the condition is in this range minimizes penalty cost incurred from deferring maintenance and results in life cycle cost savings. In general, the theoretical sweet spot is a CSCI range of 70-80 based on the associated condition index scale. The practicable sweet spot represents a user defined condition standard for triggering work. The standard, which can be different for different component-sections, is a minimum desired condition level. This standard is based on desired performance and risk criteria, including building use, building importance, component importance, etc.

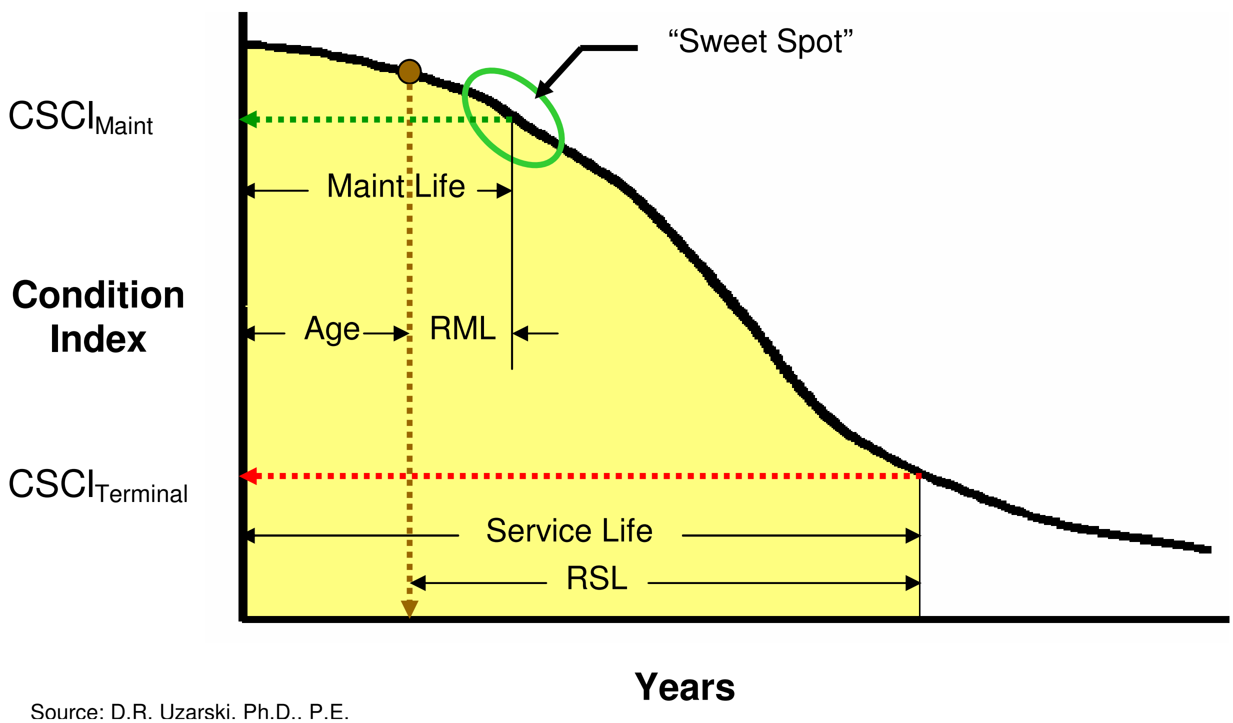

Figure 2. Component-Section Life Cycle Condition Curve

When a component-section is replaced, its life cycle curve essentially resets, using condition and service life information measured over the previous components lifecycle, to predict future deterioration rates and life. When maintenance and or repair is performed, the life cycle curve does not reset. Instead, the CSCI experiences a step increase and remaining service life is consequently extended. The service life extension (measured in terms of years) is a function of the extent of the work performed (as represented by CSCI gain) and the age when the work was completed. In theory maximum CSCI gain from repair is to a value of 100, but the post-work CSCI will be less if not all of the distresses are eliminated, as is usually the case. A new maintenance life is also set. Figure 3 displays these concepts.

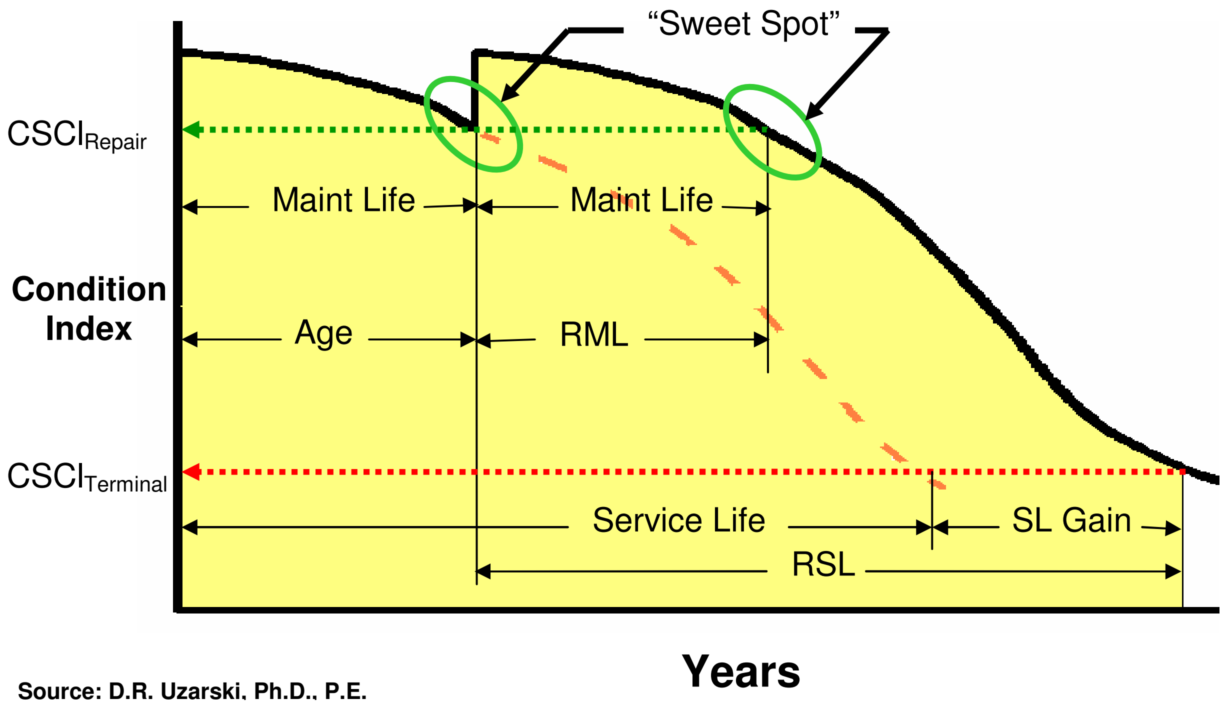

Figure 3. Component-Section Life Cycle Condition Curve after Maintenance

KNOWLEDGE-BASED CONDITION SURVEY INSPECTION TYPES

BUILDER offers different types of condition survey inspections. Each is described in detail in subsequent chapters in this manual. The purpose here is to address what they are and their suggested application. Sampling (discussed in detail later in this chapter) is permitted for all of the approaches and desired if the component-section is large, complex, and/or discontinuous. Building component-section condition survey inspections encompass:

- Distress surveys with distress quantities
- Distress surveys with distress density
- Direct condition ratings
- Paint ratings

Distress Survey with Distress Quantities

The distress survey procedure with distress quantities is the most accurate and reproducible approach. It also provides a record of the type of distresses present (e.g. cracked), their severity levels (e.g. High), and their quantity (e.g. 20 LF) for the component-section. It also provides for an accurate computation of density. This survey type can be accomplished at any time as it provides the most complete picture of the component-section and, thus, provides information of maximum value for a range of managerial decision support needs (discussed below). However, this survey is also the most time consuming and expensive to accomplish.

Distress Survey with Density Estimation

The distress survey procedure is similar to that with distress quantities except the quantities are not normally recorded. Since quantities are not recorded, density cannot be computed. Instead, the density (distress quantity divided by subcomponent amount) is estimated within a pre-defined range. The utility value of the information is less than if the quantities were recorded, but the process is faster and more economical. However, the error rate is higher. Distress quantities may be collected for the basis of computing density on those occasions when estimating is difficult or uncertain.

Direct Ratings

The direct condition rating procedure is a less accurate, but faster method for performing a condition survey. It involves visually inspecting each component-section, evaluating that item against a set of rating criteria, and selecting the appropriate rating. No information is collected regarding distresses.

Paint Ratings

Paint ratings are used to evaluate painted surfaces. Based on the original work of Marshall, et al. from the U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL), the rating is similar to direct ratings.

Normally, when sampling is applied to component-sections, sampling is applied to the paint (if painted), as well.

KNOWLEDGE-BASED CONDITION SURVEY INSPECTION OBJECTIVES

Several objectives result from performing condition surveys. These include:

1. Determine the quantitative condition of the component-section using the Component-Section Condition Index (CSCI),
2. Determine the aggregate condition indexes for the building component (BCCI), system (SCI), building (BCI), and higher,
3. Provide a measurable condition history trend,

4. Compute measurable condition deterioration rates,
5. Calibrate lifecycle condition prediction model curves (Figure 2),
6. Compute (or re-compute) the remaining maintenance life from condition model trends based on the established "sweet spot."
7. Determine the broad scope of work for planning purposes, including a scoping cost estimate for current or future maintenance or component-section replacement,
8. Determine at what point does replacement become a more viable option than repair,
9. Compute (or re-compute) the estimated remaining service life, and
10. Provide a quality control assessment for completed work (post-work assessment).

Every time a condition survey inspection is performed on a component-section the CSCI will be computed for it. Additionally, all of the roll-up CIs will be updated as well. Also, the rate of deterioration, remaining service life and remaining maintenance lives are also computed. BUILDER always displays the CSCI as of the last inspection, the estimated CSCI, and the remaining service and remaining paint lives (if painted) as of the current calendar day.

SUGGESTED CONDITION SURVEY INSPECTION TYPE APPLICATIONS

Table 1 lists the condition survey inspection purpose and the type of survey that can be conducted to meet that purpose. As can be seen, the distress survey with distress quantities satisfies all of the purposes. However, sometimes this is an "overkill" of inspection resources. Inspection savings will result by matching the least costly method to satisfy the need.

Table 1. Condition Survey Inspection Matrix by Objective

Objective	Distress w/Qty	Distress	Direct
1. Determine Condition of Component-Section (CSCI)	Best	Better	Good
2. Determine Roll-Up Condition of System, Building, etc.	Best	Better	Good
3. Provide a Condition History	Best	Better	Good
4. Compute Deterioration Rates	Best	Better	Limited
5. Calibrate CSCI Prediction Curves	Best	Better	Limited
6. Compute/Re-compute RML	Best	Better	Limited
7. Determine Broad Scope of Work for Planning	Good	Limited	Limited
8. Establish when Cost Effective to Replace	Better	Good	No
9. Compute/Re-compute RSL	Best	Good	Limited
10. Quality Control (Post-work Assessment)	Better	Good	No

Although different condition survey inspection approaches can used for the same objective, there are various factors that need to be considered when selecting the appropriate one. The first relates to where on the life cycle curve the component-section is estimated to reside at the time of inspection. Figure 4 displays in a general sense the type of sustainment/restoration (i.e. work) needs based on condition. Figure 5 matches a suggested condition survey inspection type to condition in support of those work needs. For example, if the RML is believed to be years away, a direct rating may suffice. However, if the RML is believed to be a year or less, and it is desired to do the work to correct the deficiencies, the distress survey with quantities is needed.

Condition Zones

In general, each condition zone indicated in Figure 5 will have its own condition survey inspection requirements. These are addressed below.

Zone 1 – "Preventive Maintenance (PM) Sustainment" Zone

Zone 1 is the "PM Sustainment" zone. However, although no work (other than preventive maintenance and/or emergency/service calls, if needed) is planned for this zone, condition surveys are needed to satisfy objectives 1 through 6 (see Table 1). Direct ratings and paint ratings satisfy this requirement. (Note: computing the RSL isn't of prime consideration here since it will typically be well into the future). Also, although future work requirements (objective 7) are generated from these surveys, most often those requirements will occur past the normal planning horizon.

Objective 11, quality control (post-work assessment), is also accomplished in this zone because of the raise in CSCI from the work. If the post-work assessment of the component-section reveals a "Defect Free" condition, either the distress survey or the direct rating approach may be used. If the intent was to not attain a "Defect Free" condition, the distress survey (with quantities or density estimation) should be done to document the remaining distresses. This survey should be done as soon as practicable after the work is completed. (Note: Unless overridden by a condition survey, BUILDER assumes a post-work CSCI of 95 unless the component-section is replaced. Replacement gives a CSCI of 100.)

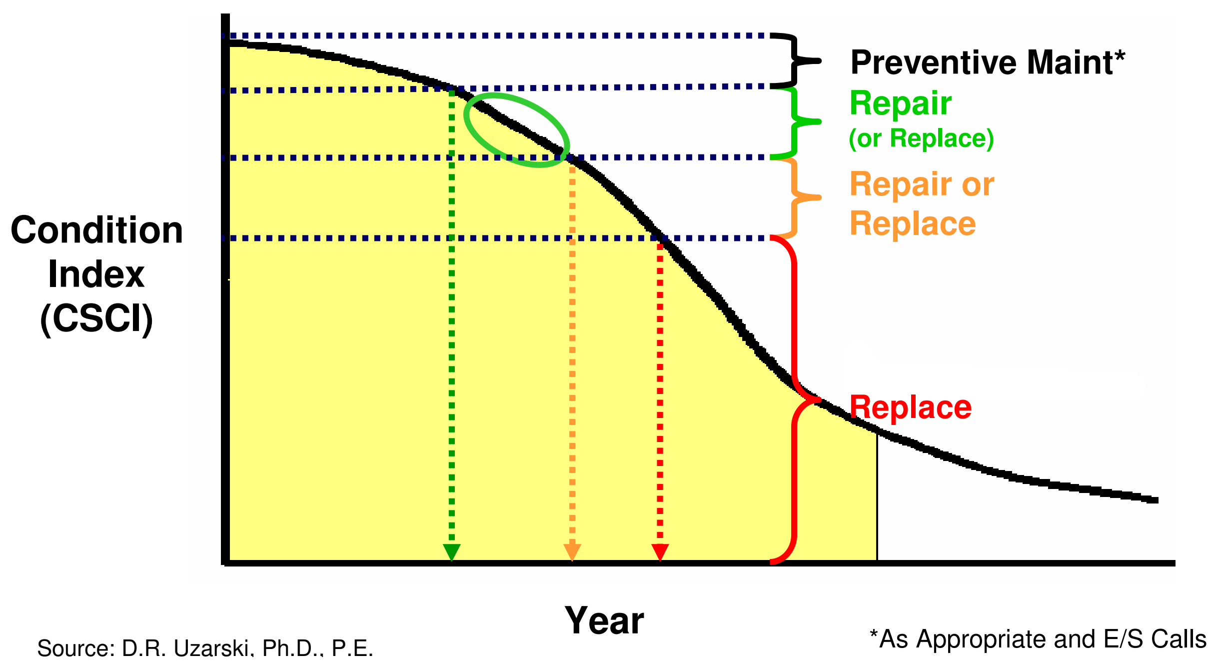

Figure 4. General Sustainment/Restoration Needs Based on Condition

Zone 2 - "Corrective Maintenance (CM)" Approach Zone

Zone 2 is the "CM Approach" zone. Although no work (other than preventive maintenance and/or emergency/service calls, if needed) is usually planned for this zone, condition assessment surveys are needed to satisfy purposes 1 through 7 (see Table 1). However, since the corrective maintenance "sweet spot" is being approached, a greater precision to the condition assessment is needed. Thus, the distress survey with density estimation is suggested.

The CSCI boundary between Zone 1 and Zone 2 is a function of the beginning of the "Sweet Spot" zone (Zone 3, discussed next). That CSCI value, rate of deterioration, and the desired long-range work plan horizon (e.g. five years) are used compute the Zone 1/Zone 2 boundary. For example, if the "Sweet Spot" CSCI value is 70, the rate of deterioration is 2 points/year, and the long-range work plan horizon is five years (five year plan), the "Sweet Spot" approach zone begins at a CSCI of 80.

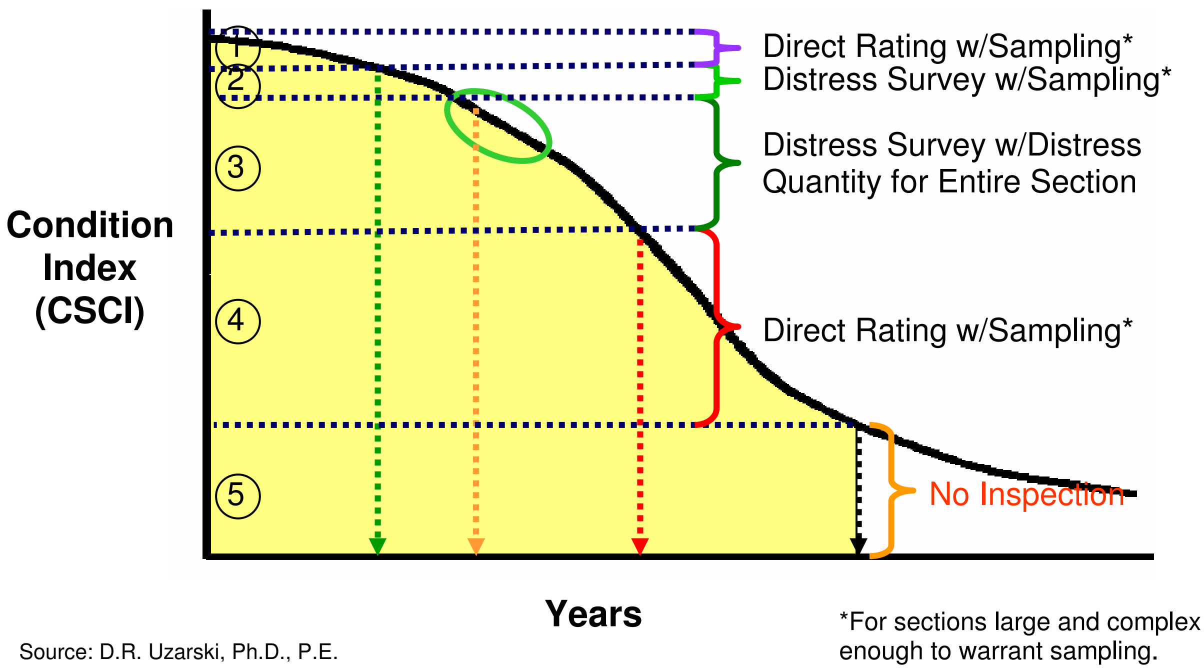

Figure 5. Suggested Condition Survey Inspection Types for Specific Condition Ranges (Zones)

Zone 3 – "Appropriate Corrective Maintenance" Zone

Zone 3 is the "Appropriate Corrective Maintenance" zone and is defined by the "sweet spot." Meeting the objective of quantifying distresses for work accomplishment (objective 8) is most important. This quantification is needed to refine the scope of the work and accurately estimate the cost in preparation of funding and accomplishment. This creates a "job" for the "job jar." To do this, the distress survey with distress quantities is recommended. Objectives 1 – 6 will also be met, but they are of secondary importance at this point. Sampling can be used for this, but if sampling is accomplished, 100% should be done. Paint ratings, if painted, will normally be accomplished at the same time. If it is determined that not all of the component-section requires work, consideration should be made to split the existing component-section into two or more parts.

Figure 5 shows that this zone extends past the "sweet spot." Due to competing priorities, budget constraints, and other factors, not all work will be executed as planned or the plan may require that some work be deferred. With deferment comes continued degradation that must be documented through a distress survey with distress quantities. Also, continued degradation may progress to the point where replacement becomes the preferred alternative. Objective 9 calls for that analysis and is met here. The key here is the timing of these surveys. Timing will be discussed below under the topic of "Knowledge-Based Condition Survey Inspection Timing and Frequency."

The CSCI boundary between Zone 2 and Zone 3 (the hitting of the "sweet spot") is set by the facility manager. It's based on two factors. One is economic criteria for minimizing the penalty cost that accrues from deferring work. The second is the condition standard at which the component-section should not drop below. Often the economic criterion is rolled into the setting of the standard. Technically, the boundary should be "Sweet Spot" minus one year to allow for a quantification of scope and the addition of the job to the job jar "just in time" for the next annual, well defined and scoped work plan. This boundary is set in BUILDER and serves as the "trigger point" for executing (or at least identifying the component-section candidates from which to prioritize) work.

The "sweet spot" need not be the same for all buildings or building component-sections. Building importance (as measured by the MDI or other means) and component importance are criteria to use. The idea is that the most important or critical inventory will be maintained to a higher level than the least important inventory.

Zone 4 – "Missed Opportunity" Zone

Often (and unfortunately) the condition of component-sections will degrade well past the "sweet spot" before work is accomplished on it. In the "Missed Opportunity" zone, life remains for the component-section, but the degradation is such that replacement or major rehabilitation is now the best option from an economic perspective. The replacement or rehabilitation may be either sustainment or restoration depending on whether or not the degradation is more or less "normal" or clearly premature, respectively. Once in this zone, the primary objective is to determine how much life remains (objective 10). The direct rating satisfies this goal. Since replacement is warranted, there is no longer a need to document distresses. Since painting will be included in the replacement or rehabilitation (if the component-section is painted), there is no longer need to do paint ratings. The estimated Coating Condition Index (CCI) will be used in the CI roll-ups as that will provide sufficient accuracy. Objectives 1 – 5 and 7 are also met.

Zone 5 – "Dead" Zone

At this point, the component-section is past its service life. For all practical purposes, it's dead and immediate replacement or major restoration is the only viable option (assuming that the component-section is still needed). No further condition surveys are needed. The estimated CSCI value satisfies objectives 1 – 3. All of the other objectives either cannot be met or they are meaningless with CSCIs so low. If the component-section is past it's normally expected service life the work would be considered sustainment. If the "death" is premature, the work would be considered restoration.

Exceptions

The generalized discussion above applies to a great many component-sections. However, there will be situations and/or component-sections that dictate a different condition survey inspection strategy. Three such situations are described below. Other specific situational based possibilities may occur in practice.

<u>Non-maintainable</u>. Occasionally, a component-section is not maintainable (other than applicable preventive maintenance). In these cases, it will be simply replaced when needed. This generally involves two cases. The first is a run-to-failure option with minimal disruption due to the failure. An example would be an inexpensive bathroom exhaust fan. This is a low risk situation. Condition surveys are not really needed in this situation. High risk situations, however, require that replacement be accomplished prior to failure because of the magnitude of the resulting disruption. An example would be a sump pump in a high water table area. In this case, the "sweet spot" is set at a point in time prior to the end of the service life. The number of years ahead is based on the tolerable risk. (The determination of service life is NOT an exact science.)

<u>Subcomponent Accessibility</u>. Distress surveys require the viewing and recording of distress data for each subcomponent of the parent component-section. Direct ratings, on the other hand, are focused on the entire component-section (or sample thereof). Unfortunately, sometimes not all of the subcomponents are readily visible during a routine condition survey. This situation is likely for certain HVAC components, especially when in operation. Thus, even though a distress survey may be warranted, it may not be possible, necessitating a direct rating.

<u>Catastrophic Event</u>. A catastrophic event, (e.g. storm damage, fire, etc.), will alter the life cycle curve for a component-section. Often after a catastrophic event, some type of condition survey inspection will be required. The type will depend of the nature and extent of the damage and the urgency for repair.

<u>Rapid Rate of Deterioration or Short Service Life</u>. These are related in that Zone 1 and possibly Zone 2 may be skipped because the "sweet spot" is rapidly approaching.

KNOWLEDGE-BASED CONDITION SURVEY INSPECTION TIMING AND FREQUENCY

Thus far, the discussion has focused on the type of condition survey inspection to perform. Nothing has been said about when or how often they should be accomplished. Traditionally, the frequency of condition survey inspections is set on some sort of a fixed schedule. They may be two year, three year, or something else based on facility importance, available funding, policy and doctrine, and other factors. Unfortunately, some component-sections will be inspected too often and others will not be inspected often enough.

Knowledge-Based Condition Survey Inspection Scheduling Concept

The knowledge-based condition survey inspection (KBCSI) approach (US Patent 7,058,544) abandons the fixed schedule approach in favor of a flexible one based on supporting the objectives described above. The KBCSI approach looks at the expected CSCIs of all of the component-sections and uses that information to compute values for RSL, RML, condition zone location, and rate of deterioration and uses those criteria, plus others, recommends those component-sections for condition survey inspection in a given year. Implementing flexibility requires an understanding of the criteria involved and the setting the applicable value to the variable used in the criteria.

Scheduling Criteria

The criteria are listed below followed by an explanation.

- Building importance,
- Component-section importance,
- Service life,
- Remaining service life,
- Maintenance life,
- Remaining maintenance life,
- Rate of deterioration,
- Condition zone,
- Condition standards, and
- Maximum timeframe between condition surveys.

In the future, other criteria can be used to help schedule. Specific criterion may include, but are not limited to: Specific distress tracking, service-call history, and preventive maintenance history.

Building Importance

Logically, the buildings that are most important should demand more attention than the buildings that are least important. Importance is measured by the Mission Dependency Index (MDI). If a MDI analysis has not been performed, building use can be used as a surrogate metric.

Component-Section Importance

Also, logically the component-sections that are most important or critical to building usefulness should demand more attention than the component sections that are least important. A metric for measuring component-section has been developed by ERDC-CERL. As an alternative, building importance could be used as a variable.

Service Life

All other factors being equal, component-sections with shorter service lives need to be inspected more often than those with longer lives because less change is expected from year to year.

Remaining Service Life

Remaining service life is important when the component resides in zones 1 and 5. In zone 1, if the RSL is long, inspection is needed less often than if it is short. Also, in zone 4, condition survey inspections should be scheduled at specific points prior to RSL going to zero.

Maintenance Life

Component-sections with shorter maintenance lives need to be inspected more often than those with longer lives because less change is expected from year to year. If the frequency is too far apart, it's possible to slip by the "sweet spot" between condition surveys.

Remaining Maintenance Life

The remaining service life will set the timing for condition surveys. RML minus one year is a key time for performing a condition survey inspection. Also, as the IMPACT program (developed by ERDC-CERL) and deployed with BUILDER will recommend work needs in future years which can them be imported back into BUILDER. This forms the basis for the long range work plan. Scheduled year minus one year should be a condition survey inspection with distress quantities.

Rate of Deterioration

Component-sections that are rapidly deteriorating need to be inspected more often, especially if the rate is greater than expected.

Condition Zone

As discussed above, the condition zone serves to determine the type of condition survey to perform. It also affects frequency when viewed with RML and RSL.

Condition Standards

Standards affect condition zone range, building importance, and component-section importance, which in turn affect condition assessment frequency.

Maximum Timeframe between Condition Surveys

Applying the above criteria may result in specific component-sections not getting a condition survey inspection for several years. This criteria assures that no more than a certain number of years transpires between condition surveys.

CREATING KNOWLEDGE-BASED CONDITION SURVEY INPECTION PLANS

BUILDER Version 3.0 is the first version that has a feature for creating condition survey inspection plans. Users may use any or all of the criteria described above for establishing the timing, frequency, and detail of component-section inspectons in a given year. Users are able to set the desired variables for the criteria.

Implementing BUILDER requires the creation of the BUILDER database, which includes the collection of system inventory data. Usually an initial condition survey inspection is also conducted of all component-sections. The KBCSI approach is recommended here, too. Not only will the appropriate condition survey type be selected, but also some component-sections may not require a condition survey at that time. Likely candidates for no condition survey are those that are relatively new and the service life is long and those past their service life. However, the user is cautioned that in order for KBCSI to properly plan, the inventory must be first collected and accurate, especially as to material/equipment type, component type, and age. The use of rapid data modeling approaches for inventory may result in considerable error. (Refer to BUILDER Inventory Manual). This error may result in KBCSI assigning an incorrect condition survey type and year.

PREVENTIVE MAINTENANCE INSPECTIONS (PMI) AND CONDITION SURVEYS

Preventive maintenance inspections (PMI), when implemented, are conducted periodically to inspect, clean, adjust, replace (or clean) filters, or otherwise maintain certain building components, particularly equipment. These PMIs provide an opportunity for PM inspectors to perform distress surveys of all of the subcomponents associated with a specific component. This is due to the subcomponent access afforded by the PMI. Having PM inspectors do these surveys will overcome the difficulty (and sometime impossibility) of performing distress surveys by other building inspectors during the course of a routine building inspection. As discussed earlier, a lack of subcomponent accessibility limits condition surveys to direct ratings.

INSPECTING THROUGH SAMPLING

Performing a condition survey inspection (distress or direct rating) by sampling should be done when the component-section is large, complex, and/or discontinuous. In a practical sense, this means that the entire component-section is not readily viewable. The decision to sample or not will be a judgment call made by the inspector based on building size and component-section amount. Sampling rates (above the minimum addressed below) are up to the discretion of the inspector and/or organizational policy. Both sampling and non-sampling approaches can be used in the same building for different component-sections. Examples of when sampling is desirable include, but are limited to: any component-section with the unit-of-measure "each," a quantity greater than one, and each one well separated from another; component-sections spread over several rooms; and exterior walls on all but the smallest of buildings.

Samples may be representative or non-representative. Representative samples are those that are in a "typical" condition for the component-section as a whole. This does not mean that they are exactly in the same condition. Some variation is expected. Non-representative sample are those that are not in typical condition for the component-section as a whole. This can be either significantly better or worse condition. The designation as representative or not will affect the condition index. Non-representative samples are considered isolated and thus have less of an influence on the condition index than representative samples.

Representative sample locations and sample sizes are determined by the layout of the given building. There are a few simple rules to follow.

Representative Sample Creation and Selection

- A general walk through of the building is recommended prior to selecting samples to ensure that they are representative.
- Use discreet building discontinuities (e.g. entire rooms, wall corners,) to help delineate sample boundaries especially when the quantity has a unit of measure of square feet (square meters) or linear feet (meters).
- When an area of the building (i.e. specific room) is selected for sampling, it is recommended, but not required, that all of the component-sections present at that location be inspected as part of the sample (e.g. all component-sections for all systems found in a room).
- Specific component-sections with a unit-of-measure of "each" should most often be sampled individually, (e.g. sample five of 25 interior doors as five separate samples).
- Sample sizes for component-sections with a unit-of-measure of "each" need not be restricted to one (see discussion below on "The Importance of Sample Locations").
- Sample sizes are often situation specific. Try to have them of approximate equal size, but be practical. There will be situations when this is not possible or practical.
- Ensure that all samples are properly identified as to location, including room number or name, if applicable, (think of the next person – can he/she easily find this location?).
- When sampling is used for a given condition survey inspection cycle, either the distress survey or the direct condition rating approach may be used for a given component-

section. However, do not combine the methods for a given component-section (i.e. distress survey for one sample and direct condition rating for another sample).

Minimum Representative Sample Quantities

- The numbers of representative (as to condition) samples to be taken of a specific component-section with the unit-of-measure of "each" are:

  - One (1) sample when the component-section quantity is 1-4.
  - Two (2) samples when the component-section quantity is 5-9.
  - At least three (3) samples when the component-section quantity is 10 or more.
  - AND a minimum of 10% of the component-section quantity.

- The number of representative (as to condition) samples to be taken of a specific component-section with the unit-of-measure of square feet (square meters) or linear feet (meters) are:

  - One (1) sample when the number of potential samples is 1-4.
  - Two (2) samples when the number of potential samples is 5-9.
  - At least three (3) samples when the number of potential samples is 10 or more.
  - AND a minimum of 10% of the component-section quantity.

Sampling Suggestions

- Specific rooms inside of a building (e.g. "Room 110"), where all of the various component-sections in that room would be sampled (e.g. ceiling, walls, wall finish, floor, floor covering, light fixtures, etc.).
- Exterior wall locations (e.g. "North Wall," etc.), where all component-sections included in that wall would be sampled (e.g. wall surface, doors, windows, awnings, lights, etc.).
- A component-section consisting of ten roof ventilating fans (all ten are the same), samples could be "Fan 1", "Fan 2", etc.
- Interior doors denoted by room number (e.g. a hallway has many doors leading to rooms, so select the requisite number of doors with each door being a sample).
- Specific structural columns, beams, frames, trusses.
- A specific component-section (e.g. fireplace) with a quantity greater than one, but still a small number (e.g. two or three) and they are geographically separated such that they cannot be inspected together. Inspect each one as a sample with a specific location. All need to be inspected to be in conformance with the minimum sample quantity addressed above.
- If an entire component-section happens to be co-located at a defined sample location where other component-sections were sampled (e.g. a fireplace in a room selected for sampling of walls, ceiling, flooring, etc.), that component-section can either be included in the sample location or simply inspected without sampling.
- In general, do what makes sense, but ensure that the rules are followed.

Non-Representative Samples

- Inspect non-representative component-sections in addition to the required representative sample quantity amounts.
- Ensure that the non-representative samples are designated as such.

Unusual Condition Situations

Recall, a primary objective for conducting condition survey inspections is to compute a CSCI for the component-section. This CSCI is used for a variety of purposes including developing work plans. Also, it was stated above, that non-representative samples should be inspected and classified so when warranted. These non-representative samples may be in significantly worse condition than the component-section as a whole and *may* merit work sooner than the component-section as a whole (i.e. the work cannot wait until the remainder of the component-section deteriorates to the point of needing work). In these cases, it is possible that BUILDER will not trigger work for the component-section because the overall condition does not warrant it (the CSCI may be in the "Do Nothing" zone). These situations offer managerial alternatives. One alternative is that the distresses can be "flagged" for early work (discussed in the next chapter). Another is that component-section can be split with the portion that is significantly worse forming its own component-section. An example is a component-section of structural columns in a warehouse. Generally, they are in condition where no work actions are needed EXCEPT one column that was severely damaged by a forklift. Splitting this one column into its own section with its resulting low CSCI is an option.

Sampling to Quantify Work Needs

Sampling may also be used when a distress survey with distress quantity is used to quantify/refine work needs. However, the sampling rate must be increased to 100%. For component-sections with a unit-of-measure of square feet (square meters) or linear feet (meters) the choice to sample or not is based on convenience. It may be easier to record all on a smaller sample-by-sample basis than for an entire component-section. Component-sections with a unit-of-measure of "each" should always be inspected individually when work needs are being quantified. For example, if a component-section consists of ten roof ventilating fans, each fan would be a separate sample and each would be inspected. Thus, ten samples would result.

The Importance of Sample Locations

The importance of sample locations cannot be overemphasized. The above topics briefly touched upon sample locations, but two important considerations of inspection data management (past, present, and future) and field data collection practicalities are addressed below.

First, the sample location creation possibly provides a basis for collecting condition survey data for a number of different component-sections. For example if a room were chosen as a location, the walls, ceiling, light fixtures, etc. could all be inspected and associated with the same location. This can be very useful for future inspections even if all of the component-sections are not inspected in a given cycle, because a method of sorting inspection data is by sample location. These locations can be used year after year and will be illustrated later in this manual.

Second, the creation of sample locations will affect sampling rates and sizes. It was stated earlier that component-sections with the unit-of-measure of "each" should be sampled individually. However, sometimes this is impractical. If a sample location has been created that covers a specific area, such as a room, the component-section may have a quantity of more than one in that room. A logical clustering of individual items may form a practical basis for a sample. An example would be a component-section quantity of 100 light fixtures in a building. A room being sampled may have four fixtures out of that total component-section quantity. The intent would to not inspect each light fixture in the sample location room. Rather, all four light fixtures would encompass a single sample. Under these circumstances it becomes important to make all sample sizes roughly the same for a given component-section. That is, avoid one sample of four lights and another sample of 40 lights.

BUILDER REMOTE ENTRY DATABASE (BRED)

To facilitate the condition survey inspection process, BUILDER Remote Entry Database (BRED) software was developed for use with pen-based electronic clipboards, laptop computers, and desktop computers. BRED is a Windows™ 98/NT/2000/XP application. Use is optional, but offers advantages over paper forms. These include:

- Distress definitions are available on screen,
- Recorded condition survey data are easily uploaded into the BUILDER database,
- Data loading from paper to computer is eliminated, reducing error and saving time,
- Previous condition survey data and sample locations are available on-screen,
- Drop-down lists of the component-sections pertaining to the inspected building are provided,
- The condition survey checklists are provided on screen,
- Component-section amounts are displayed on-screen,
- A tally is provided that informs of the number of samples and percent sampled,
- Inventory can be collected for loading into BUILDER, and
- Inventory can be verified and updated during the condition survey.

There are some challenges, as well. These include:

- Battery life is limited possibly necessitating the carrying of spares,
- There is an additional piece of equipment to carry,
- The pen-based computer can feel heavy and awkward,
- Under bright sunlight conditions, the screen may be hard to read (depending on model), and
- If a computer crash or software malfunction occurs, productivity suffers.

The illustration of BRED usage will be introduced in the remaining chapters of this manual, but is beyond the manual scope to describe detailed BRED operations. A help file is provided with the BRED software that covers the range of operations and usage, including data transfer.

Virtually any pen-based tablet computer or laptop may be used to operate BRED. BRED will also work on desktop computers. Normally these computers, as purchased, have sufficient memory and disk space. BRED does require Windows™ 98, 2000, XT, or XP to operate. Windows™ ME will not work. Also, pen-based tablet computers should not be confused with palm type computers. BRED will not work with the latter.

USING ROOFER EMS WITH BUILDER EMS

BUILDER can import ROOFER data, but the reverse is not true. BUILDER uses roofing information from ROOFER to perform full building analyses, CI roll-ups, and comprehensive work planning. BUILDER also uses the ROOFER distress definitions (included in this manual). ROOFER does not have a direct rating procedure and ROOFER's distress surveys include the recording of distress quantities. ROOFER provides for a more detailed inventory of roofing components and performs specific roofing analyses that BUILDER does not. Also, ROOFER computes a specific Roof Condition Index (RCI) that BUILDER does not.

ROOFER could be used for all of the required condition survey inspections. Alternatively, ROOFER could be used at specific points in the roof life cycle. ROOFER usage is certainly appropriate for the condition survey inspections conducted in condition zone 3. Expanded usage is at the discretion of the user and/or the organizational business process.

INSPECTION DATES OF RECORD

Each component-section in a given building need not be inspected on a given day. In fact, in many instances this will be impossible. However, each component-section must be associated with a given date for each inspection cycle. Even if inspecting the component-section takes more than one day, only one date shall be reported. If multiple dates are reported, BUILDER will interpret these as totally different inspections. Reasons why the inspection of a component-section may take more than one day are: Component-section amount or complexity, weather interruptions, accessibility, item location, inspector sickness, emergencies, and other priorities.

BRED automatically provides for a five (5) day inspection window. Once an inspection date is established for a given component-section condition survey inspection, inspectors have five days to complete the survey. The addition of more data, such as another sample, any time in the five days will automatically be associated with the established date.

INSPECTOR QUALIFICATIONS

To do a proper condition survey inspection, it's important that the inspector be qualified in the task. This entails recognition of the various subcomponents, their applicable distress types and severity levels. Also, the inspector must be able to accurately estimate density and measure quantity. Technicians well versed in civil/architectural, electrical, and mechanical systems will be qualified as inspectors. A team approach will be needed if a single inspector is not well versed in one or more of these areas.

There may be components present that require inspection by certified personnel. This may include such items as elevators, boilers, fire protection equipment, etc. When present, those components must be inspected as per their prescribed procedures. The results of these specialized inspections should be translated into BUILDER for management use and condition analysis.

Prior to commencing a round of periodic condition survey inspections, it is strongly recommended that inspectors undertake refresher training on the procedures. This will involve:

- Reviewing the distress and component rating definitions,
- Practicing estimating density,
- Practicing measuring quantity,
- Reviewing sampling procedures,
- Preparing the survey forms (if used),
- Using the BUILDER Remote Entry Database (BRED) (if used), and
- Performing a practice survey at a benchmark building.

An eye trained for proper observation and an accompaniment by simple diagnostic tests, where applicable, are critical to quality inspections. Know what to look for and record accurately.

CONDITION SURVEY INSPECTION PROCESS TASKS

Pre-Condition Survey Tasks

Prior to performing a condition survey inspection, the inspector must become familiar with the component-sections present, building layout, and past inspection findings and sample locations (if any). The BUILDER database can be accessed for this information. Various reports should be run to help the inspector become familiar with the upcoming task.

If BRED is to be used (discussed below), the desired buildings and systems that are to be inspected will be first downloaded from BUILDER and loaded into BRED. If BRED is not being used, ensure that an ample supply of blank condition survey worksheets are available. These are provided separately in electronic (Microsoft EXCEL) form with your BUILDER install set. Some inspectors prefer to forego the worksheets and create their own or record “free from.”

All approaches are acceptable, provided correct and accurate data are collected and the results can be easily transferred into BUILDER.

If available, a review should be made of the service call history for the building to see if any of the component-sections to be inspected have a "history" since the last condition survey. Recurring problems can translate into distress information even if not apparent at the time of the condition survey. Also, even "one-time" calls can sometimes help explain the reason for observed stains, patches, etc.

Assemble any tools and safety equipment needed for the inspection. These include:

- This manual, especially the distress definitions (perhaps reduced to pocket size),
- Binoculars and mirror (for viewing hard to reach places),
- Flashlight,
- Twenty-five (25) foot tape and electronic or laser tape or small measuring wheel,
- Screwdriver, awl, pliers, hammer or mallet,
- Voltmeter, clip-on ammeter, circuit and GFI tester,
- Infrared surface thermometer,
- Ladder,
- Level and plumb bob, and
- Camera (if desired for supplementary documentation).

Getting Started with BRED

Prior to actually conducting the condition survey, all planning must be accomplished. This topic was discussed above and includes the knowledge-based scheduling, inventory review, etc. The buildings and systems associated with the scheduled component-sections will need to be downloaded to BRED from BUILDER. Generally, only download enough for a day or two of work.

If the survey is an initial one (no previous inspection), the decision to sample or not and the minimum amount to sample needs to have been made prior to inspecting. Inspectors should always have the discretion to increase the number of samples, if needed, to get a better representation of condition. The actual choice of samples will be made during the inspection. Ensure that they are well spaced and truly representative. Reviewing sampling procedures (described above) is recommended.

If the survey is a re-inspection, it is STRONGLY recommended that the same previously defined sample locations be chosen. If any of those locations are inaccessible, choose substitutes. Always be aware of situations that may demand more representative samples or additional samples be taken. This may be where larger than normal variation is occurring and the inspector feels more representative samples are needed to get an accurate CSCI or where uncommon conditions arise necessitating non-representative samples be surveyed. This latter case should be rare.

Once buildings are downloaded from BUILDER into BRED, all component-sections and previously defined sample locations are available to the inspector via the tree structure on the left of the BRED desktop (see Figure 6).

Samples can be accessed from the tree in two ways. The first is by the "By Sample Location" portion on the tree. Refer to Figure 6 to see this at the bottom of the tree. A second approach is to drill down through "By System." Referring again to Figure 6, this is illustrated for exterior windows. The tree expands down to show the sample locations. If samples have not been previously defined, there will be no sample locations.

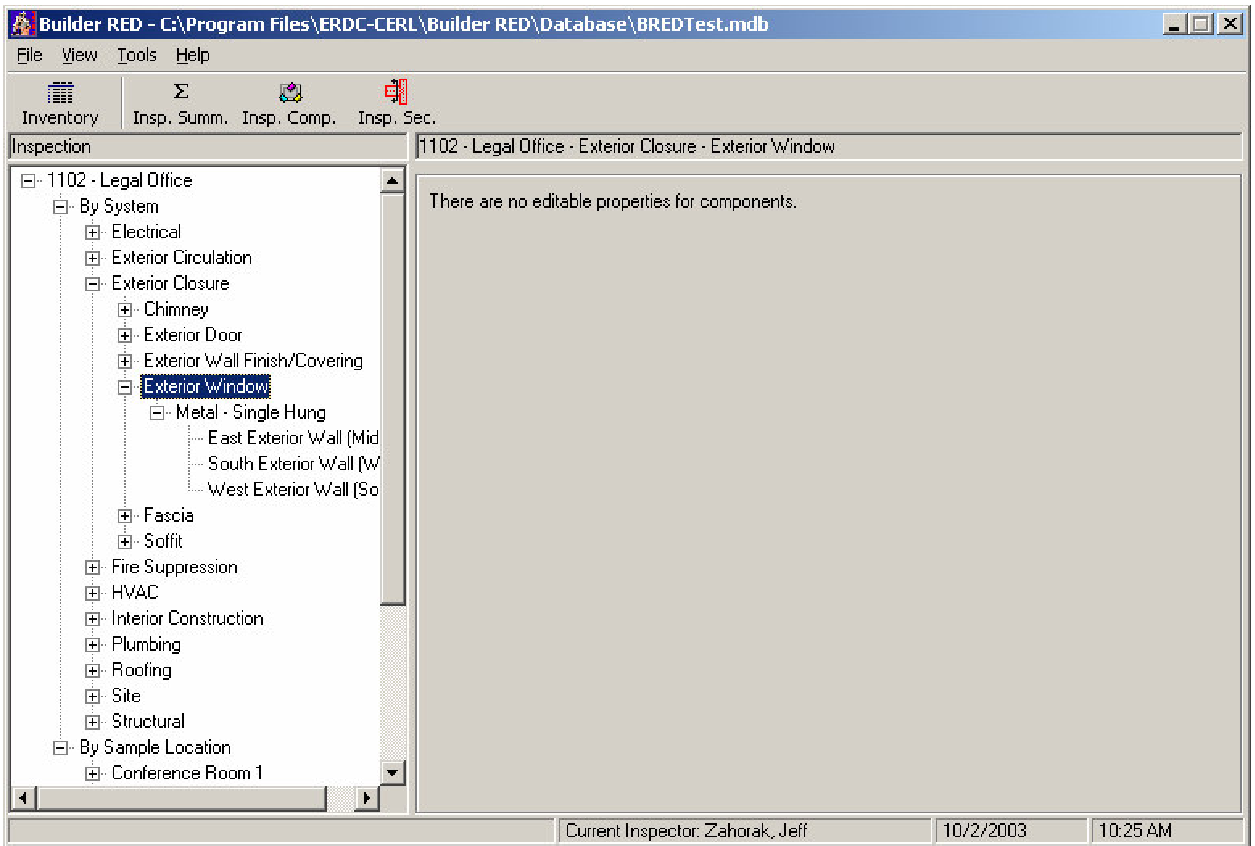

Figure 6. BRED Desktop Illustrating the Component/Sample Location Selection Tree

Performing the Condition Survey Inspection

A condition survey inspection is more than walking through a building, observing and recording problems. It also involves discussing building conditions with the building manager and occupants. Certain problems may not be obvious or they may be intermittent. A discussion with the people who work or live in the spaces can bring these to the forefront.

Certain building component-sections are very difficult, if not impossible, to observe. These may include insulation, structural members, plumbing piping, electrical wiring, and a host of others, depending on the building. When difficult observation occurs, look for subtle clues to ascertain condition. These can include uneven floors, out-of-plumb walls, water stains, sawdust, musky odors, sagging roof ridgelines, discoloration from overheating, unusual noises, etc.

Additionally, certain special buildings, due to their complexity and/or use, will require extra time and attention to detail during the inspection process. Sampling rates may need to be increased or not used at all for certain component-sections.

If available, an excellent source of information to review will be the equipment logs often kept in the mechanical rooms (or elsewhere). They can provide insight to problems and a record of work performed.

An interview with the HVAC, etc. mechanics is recommended. Typically, certain equipment will be running and cannot be shut down for an inspection and other equipment may not be turned on (e.g. heating units in summer). Often, too, certain subcomponents may not be visible to an inspector. Thus, the interview process can reveal problems (i.e. distresses) that may otherwise be missed. For example, is a pump not running because it is not currently needed for use or is it inoperable?

Other issues include:

- Plan the most efficient inspection sequence and path through the building,
- Record the condition survey findings for later transfer into BUILDER,
- Refer frequently to the direct rating and distress definitions provided in this manual,
- Ensure that all assigned component-sections are inspected,
- Ensure that sample unit naming conventions are followed,
- Ensure that the sampling procedures, when used, are followed,
- When re-inspecting and sampling, use the past sample unit locations, if possible,
- When sampling, be observant to "non-typical" conditions that warrant a non-representative sample inspection,
- Keep track of the inspection summary (discussed below), and
- Be observant to any situation that may warrant inspection, even if the component-section is not on the inspection list.

Finally, for safety and efficiency, it is often best to have inspectors work in pairs. Work safe!

Keeping Track of What Has Been Inspected

The "Inspection Summary" button (see Figure 6) provides a tally of the inspection (both distress surveys and direct ratings). As the condition survey continues, the summary updates to provide a status. This helps to ensure that component-sections are not missed and that the sample targets are met. Figure 7 displays an example.

Inspection Tally

Building	Component	Section Description	Section Quantity	# of Samps	Insp. Quantity	% Insp.
1102 - Legal Office	Interior Door	Wood-Personnel	38	3	9	24%
1102 - Legal Office	Interior Floor Finish/Cove	Carpet	7,400			
1102 - Legal Office	Interior Floor Finish/Cove	Resilient Tile	236			
1102 - Legal Office	Interior Wall	Drywall	14,134			
1102 - Legal Office	Interior Wall Finish/Cove	Ceramic	1,104			
1102 - Legal Office	Interior Wall Finish/Cove	Wood-Paneling	1,394			
1102 - Legal Office	Interior Wall Finish/Cove	Vinyl/Plastic-Wallpaper	13,030			
1102 - Legal Office	Interior Window	Metal-Fixed	1			
1102 - Legal Office	Lighting Fixtures	Incandescent-Exterior	5			

Exit

Figure 7. Example Inspection Summary

Post-Condition Survey Tasks

If the inspection findings were recorded on the paper forms, go to the inspection feature in BUILDER and enter the data. If the finding were recorded in BRED, upload the data into BUILDER through the data import feature. Experience has shown that it is easy to make data recording errors if not careful. Review the data immediately after recording to ensure accuracy and make any necessary corrections. The data should be reviewed again after loading into BUILDER for a final quality check.

2. DISTRESS SURVEY PROCEDURES

INTRODUCTION

The distress survey is the most accurate, reproducible, and consistent condition survey approach. It also provides a record of what's wrong with the component-section via the identified distresses. The survey procedure involves visually inspecting each subcomponent present in the desired component-section. The distress types, their severity levels, and their quantity or density discovered for each subcomponent are recorded. The recommended distress survey applications are discussed in detail in Chapter 1.

DISTRESS DEFINITIONS

Different sets of distress definitions are provided in this manual. Appendix A lists the distress set applicable to all building components, except built-up, single-ply, and asphalt shingle roofing surfaces and flashings. Those roofing distresses were developed for use with the ROOFER EMS and are provided in Appendices B through D, respectively. They are used with BUILDER to facilitate consistency.

At the beginning of each appendix are general notes regarding application, density estimation, and other items of importance. These should be reviewed regularly to ensure a consistent application.

It is expected that inspectors will have the distress definitions available for ready reference. This can be accomplished electronically through BRED, paper form, or both. Do not rely solely on memory for the definitions. Experience has shown that unnecessary error will result in certain situations, even from seasoned inspectors, if guesswork is used. If uncertain about a distress type or severity level, look it up!

BEGINNING THE DISTRESS SURVEY

Getting Started

Prior to actually conducting the distress survey, all planning must be accomplished. The buildings and systems associated with the scheduled component-sections will need to be downloaded to BRED from BUILDER. This topic was discussed in Chapter 1.

Selecting the Component-Section, Distress Survey Option, Sample Location, and Quantity

Referring back to Figure 6 the component-section to inspect will be chosen from the tree. The selection may come from the component list or the sample list depending on whether or not sampling is being used. The most recent last inspection date, quantity, and results will be shown as displayed in Figure 8 (no sampling) or Figure 9 (with sampling) if the last inspection was a distress survey. (If the last inspection was a direct rating or if the component-section is painted, the display will look different. Direct ratings are discussed in Chapter 4 and paint ratings are addressed in Chapter 4). Other past inspection dates may be chosen from the date drop-down list. From here a new inspection may be made from scratch or made from a copy of past inspection data based on the past date chosen. This is done by pressing either the "New Inspection" or "Copy Inspection" button next to the date field. The current date and component-section quantity will default. If the inspection is new, the distress survey radio button should be selected to display the distress survey grid. For new inspections, the quantity will default to the component-section quantity. The actual amount used for a given sample (if sampling is used) will need to be recorded along with the sample location.

Refer to the BRED help file for details on specific operations.

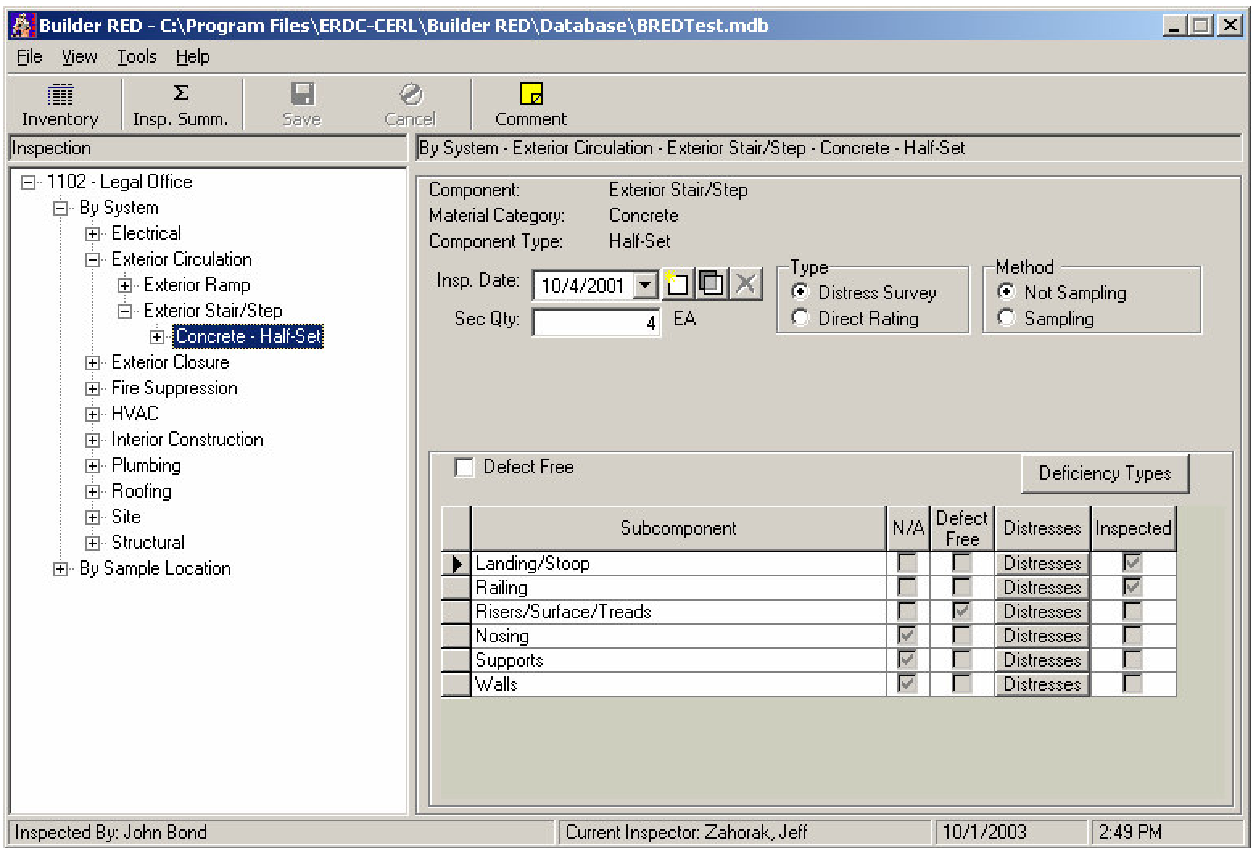

Figure 8. BRED Distress Survey Screen (No Sampling)

SUBCOMPONENT SELECTION

BUILDER distress surveys are conducted on a subcomponent-by-subcomponent basis for each component-section. However, subcomponents are not inventoried in BUILDER, per se. Subcomponents may be few or many depending on the specific component-section as constructed or installed in a given building. BUILDER and BRED address this. When the distress survey screen is accessed a listing of all possible subcomponents is provided. This is shown in Figures 7 and 8. Since BUILDER initially does not know which subcomponents are present and which ones are not, their presence is defaulted to "N/A" (not applicable). Those that are present MUST have either the "Defect Free" box checked or the applicable distresses recorded as discussed below. After the data are loaded and saved, the subcomponents will be resorted with those present listed at the top.

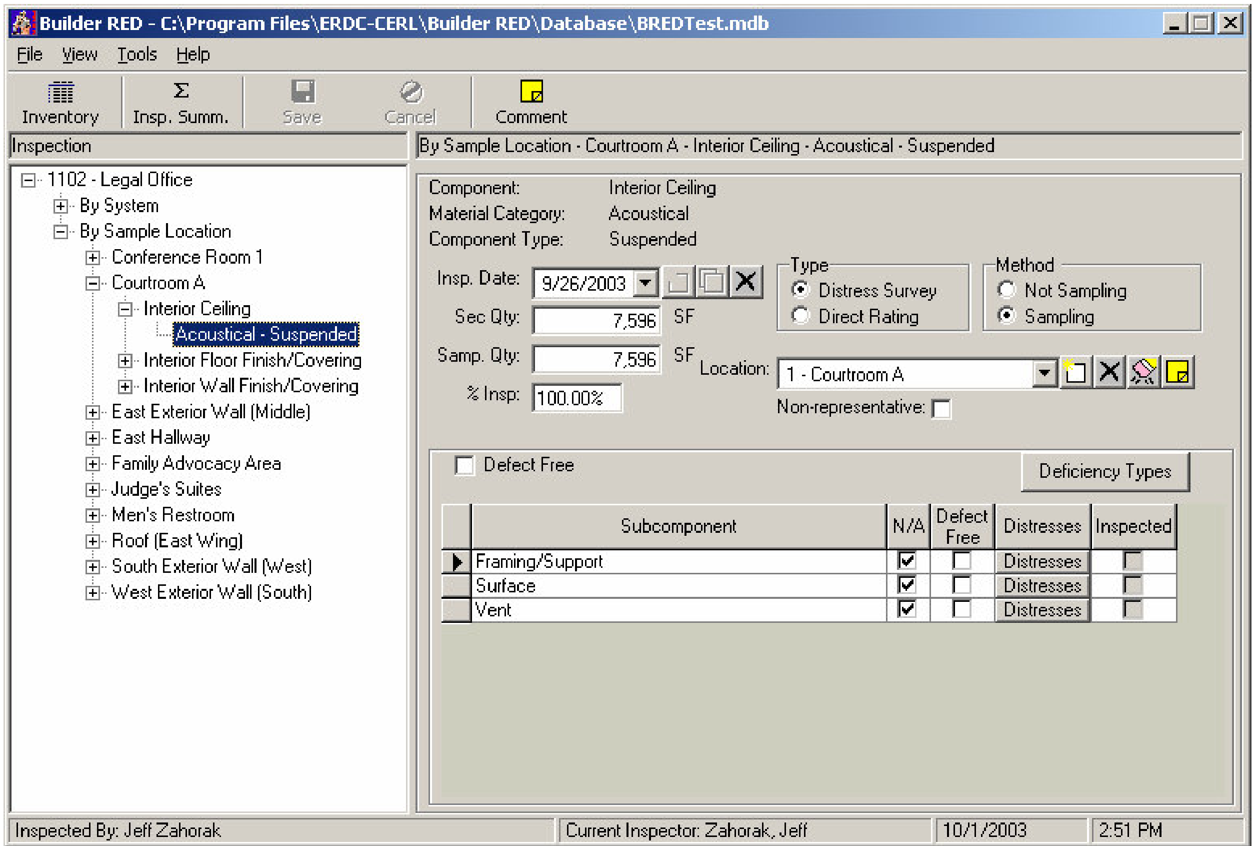

Figure 9. Distress Survey Screen (with Sampling)

If subcomponents are present, but marked "N/A" then all of the condition indexes will be computed at lower levels than they really are. Thus, it is imperative that great care be taken with this detail.

There is one exception to the subcomponent "N/A" and "Defect Free" requirement discussed above. If ALL of the subcomponents present are "Defect Free" a global declaration can optionally be made by checking the "Defect Free" checkbox (see Figures 8 and 9). This can be a timesaver.

RECORDING DISTRESSES AND OTHER DATA WITH BRED

Referring to Figures 8 and 9, the “Distresses” button on the subcomponents row is pressed to record all distresses. Look for the presence of distresses and for each found record the applicable distress type, severity level and density range (or distress quantity) for that subcomponent. Particular care must be taken to adhere to the definitions and notes for each distress (Appendices A through D). When completed, inspect the next subcomponent. When all of the subcomponents have been inspected, the inspection for that component-section or sample (if sampling) is completed. The process repeats for the next component-section or sample. Figure 10 shows a completed distress survey for a given subcomponent.

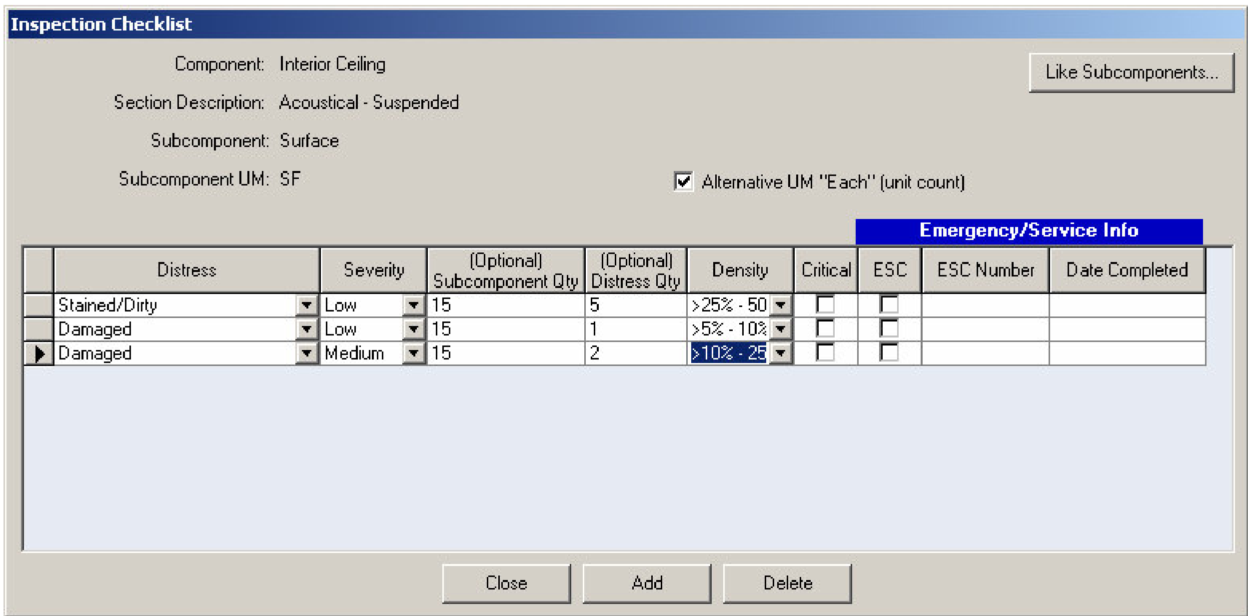

Figure 10. Completed Distress Survey for a Subcomponent

Copying a Previous Distress Survey

It was stated above that re-inspection of previously defined component-section sample units is strongly recommended. Doing this permits the copying of the last distress survey. Doing so is also STRONGLY recommended. All of the distresses, severity levels and densities for all subcomponents will be copied into the current inspection. If no work has been accomplished since the last inspection, all of the past distresses will be present. Their severity levels may be worse, the quantity or density may be more, and additional distresses may be present, of course. But for those that are the same, only verification is needed, thus saving time and effort plus adding to consistency and reproducibility. Changes can be recorded through edit. New distresses will be added as they would be for a new inspection.

To help keep track that all copied sample locations have been inspected and the data saved for each one, the sample location combo box will have a yellow background until all sample locations have been saved for the current inspection. This is illustrated in Figure 11. After all are saved, the background will revert to white.

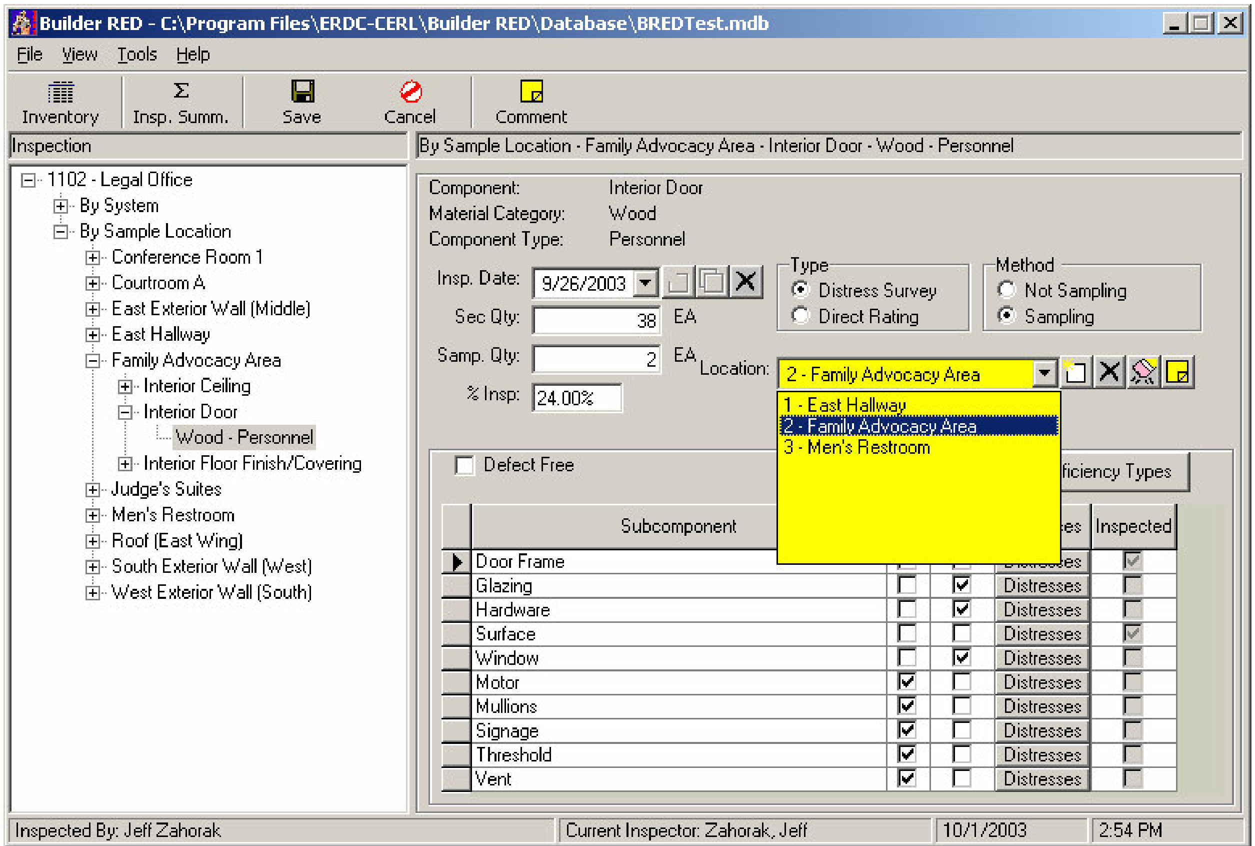

Figure 11. Distress Survey Copy Component-Section Sample Locations Shown in Yellow

Distress Density vs. Distress Quantity

There are three primary reasons for collecting distress quantity data. These are:

- When estimating density is not permitted or desired (business process decision),
- Computing actual density, and
- Quantify/refine work needs.

A BUILDER distress survey permits the inspector to record the measured distress quantities or record an estimate of density within pre-defined ranges. If quantities are entered, BUILDER or BUILDER RED will compute the density. The "Overview" chapter discussed the differences and intent of the two different approaches.

Simply recording an estimate of density is faster than recording quantity data, but it is also more error prone. Sometimes estimating density may be difficult or it may be found to be too inaccurate. If so, the distress quantities may be entered into BRED (BUILDER, too) and the appropriate density range will be computed. This is illustrated in Figure 10.

If distress quantities are used, the subcomponent quantity will also need to be entered so that density can be computed. Since subcomponents are not inventoried, BUILDER will rarely know what there values are. (There are some instances when they are the same as the component-section or sample quantity). The subcomponent quantity can be estimated or measured.

Sometimes, using a unit count instead of an area or length measurement will speed the inspection by eliminating the need to measure and compute a subcomponent area or length, provide for the necessary density computation, and offer an advantage of giving a logical repair measurement. For example, there may be 16 SF of damaged ceiling tiles in a room that is 120 SF. This could have also been gathered by counting two tiles out of the 15 present. Plus, now the repair quantity is known (i.e. two tiles). Thus, using a unit count is an alternate unit-of-measure for the subcomponent. With BRED the subcomponent unit-of-measure is displayed (see Figure 10). If the alternative unit count is used as the unit-of-measure, a checkbox to indicate that this method was used. The example in Figure 10 used this approach.

Multiple Severity Levels

Most distress types have more than one severity level defined. When conducting a distress survey the inspector must take care to recognize that more than one severity level for a given distress type may be present in the same component-section subcomponent. As an example, Figure 10 shows two different severity levels present for the same distress type.

Critical Distresses

Figure 10 shows a checkbox labeled “Critical.” This box should be checked to trigger a repair in the first year of a work plan even if there still is a remaining maintenance life (RML) for the component-section. Refer to the discussion in Chapter 1. Thus, checking “Critical” overrides the RML for work planning. “Critical” can also be used denote “Stop Gap” repairs prior to a future planned project.

Emergency/Service (E/S) Calls

The “ESC” checkbox (see Figure 10) is used to flag the need for a quick, relatively inexpensive, emergency or service call to correct a problem found during the inspection. This is different than the “Critical” flag from above. “ESC” is smaller in scope, represents unplanned work, and will be acted on with a few hours (emergency call) or days (service call).

“Critical” and “ESC” should not be used together.

If an emergency or service call has been issued from a previous inspection and an ESC number and completion date (if completed) have been entered into BUILDER, the number and date will be seen in BRED. If the past inspection is copied into a current inspection, this distress will most likely be deleted since it should no longer be present.

RECORDING DISTRESS DATA WITHOUT BRED

Distress surveys can be accomplished without BRED. The BUILDER set-up compact disk provides sample worksheets that can be used instead of BRED. Revised or custom worksheets can be created or the information can be recorded free form. The key is recording the proper data for later entry into BUILDER.

Without Sampling

For each component-section, record the system, component name, identifying section name (if used, e.g. Roof Section A), material (or equipment) type, and/or component type. These descriptors will uniquely identify the component-section being inspected. Then identify and record all distress types, severity levels, and density ranges (or subcomponent quantity and distress quantity) for the subcomponents present. An example of a completed "Distress Survey without Sampling" worksheet is shown below as Figure 12.

BUILDER EMS Distress Survey Worksheet
(without Sampling)

Building ID: 918 **Date:** 8/24/98 **Inspector:** Mike S.

System	Component	Section ID	Category/Type	Subcomponent	Distress	Sev	Density	Paint Rtg
Roofing	Surface	Roof A	Metal/Standing Seam	Surface	Leaks	H	2-5%	–
"	"	"	"	"	Patched	L	11-25%	–
"	"	Roof B	Asphalt/Roll	Surface	Patching	L	6-10%	–
"	"	Roof C	Asphalt/Built-up	Surface	Ponding	M	2-5%	–
"	"	"	"	"	Splits	L	0-0.1%	–
"	"	"	"	"	Holes, Cuts (Membrane)	L	0.1-1%	–
"	"	"	"	"	Debris and Veg	L	0-0.1%	–
"	Roof Drainage	Roof A	Metal/Ext.	Gutter	Damage	L	2-5%	G
"	"	"	"	Downspout	Loose	M	6-10%	G
"	"	Roof B	Metal/Ext.	Splash Block	Cracks	M	6-10%	–
"	"	"	"	"	Missing	L	2-5%	–

Sheet 1 of 1 **Density Ranges: < 0.1%; 0.1-1%; 1-5%; 5-10%; 10-25%; 25-50%; >50%**

Figure 12. Example Distress Survey without Sampling Worksheet

With Sampling

For each component-section included in the sample, record the system, component name, identifying section name (if used, e.g. Roof Section A), material (or equipment) type, component type, sample quantity, and whether the sample is representative or not. These descriptors will uniquely identify the component-section being inspected. Then identify and record all distress types, severity levels, and density ranges (or subcomponent quantity and distress quantity) for the subcomponents present. An example of a completed "Distress Survey with Sampling" worksheet is shown below as Figure 13.

BUILDER EMS Distress Survey Worksheet
(by Sampling)

Building ID: 571 **Date:** 6/30/98 **Inspector:** Mike M. **Sample Location:** Room 113

System	Component	Section ID	Category/Type	Sample Qty	Rep	S#	Subcomponent	Distress	Sev	Density	Paint Rtg
Int. Const.	Floor Finish	None	Carpet / N/A	150SF	Y	2	Surface	Loose	L	2-5%	—
"	"	"	"	"	"	"	Reducer/Edging	Missing	L	0.1-1%	—
"	Int. Ceiling	None	Drywall/N/A	150 SF	Y	2	Surface	Holes	M	2-5%	A+
"	"	"	"	"	"	"	"	Stains	L	11-25%	"
"	Int. Door	None	Wood/Personnel	1 EA	Y	1	Surface	Damage	L	6-10%	G-
"	"	"	"	"	"	"	"	Stains	L	2-5%	"
"	"	"	"	"	"	"	Hardware	Missing	M	2-5%	—
"	"	"	"	"	"	"	"	Corrosion	L	2-5%	—
"	"	"	"	"	"	"	Window	Cracks	L	2-5%	—
Electrical	Lighting Fixtures	1st Floor	Flourescent/Int.	8	Y	1	Ballast	Loose	H	>50%	—
"	"	"	"	"	"	"	"	Operationally Imp	H	>50%	—
HVAC	Ventilation/Exhaust	None	Wall Louver/N/A	1	N	1	Surface	Corrosion	M	6-10%	A-
"	"	"	"	"	"	"	"	Loose	L	11-25%	A-
"	"	"	"	"	"	"	"	Excessive Noise/Vib	M	6-10%	A-
"	"	"	"	"	"	"	"	Stains	L	26-50%	A-

Sheet 1 **of** 1

Density Ranges: < 0.1%; 0.1-1%; 1-5%; 5-10%; 10-25%; 25-50%; >50%

Figure 13. Example Distress Survey by Sampling Worksheet

3. DIRECT CONDITION RATING PROCEDURE

INTRODUCTION

The direct condition rating procedure is a less accurate, but faster method for performing a condition survey. It involves visually inspecting each component-section, evaluating the entire component-section against a set of rating criteria, and selecting the appropriate rating. The recommended use of the direct ratings is described in Chapter 1.

DIRECT RATING DEFINITIONS

Rating Interpretation

The direct rating approach consists of three broad categories described as "Green," "Amber," and "Red." "Green" implies that the component-section is suffering little, if any, serviceability loss due to degradation, and some sustainment (preventive maintenance or minor repairs) may be needed, but not significant enough to place on a corrective maintenance work plan. "Red" implies serious serviceability problems due to degradation and significant restoration or sustainment is needed in the form of major repair, rehabilitation or replacement. "Amber" (or yellow) ratings represent the middle and imply a sense of caution. Further analysis may be needed (i.e. a distress survey).

Each rating category is also divided into threes and are denoted by high (+), low (-), and middle. The (+) and (-) ratings serve as transitional ratings between "Green" and "Amber" and "Amber" and "Red."

Table 2 shows the direct rating definitions. The descriptive text is applicable to an entire component-section, or if sampling, a component-section sample. The definitions are not intended to totally or exactly describe all component-section situations. Rather, the rating intent, as described above should be adhered to in the inspection. The direct rating definitions are repeated in Appendix E for ready reference.

It is likely that situations will arise that are not clearly defined in the rating definitions and it may seem like two or more ratings might be appropriate. When this situation occurs chose the rating that *best* fits the situation. Table 3 is provided to help differentiate the ratings. However, before assigning a rating think carefully of the intent behind the "Green," "Amber," "Red" rating definitions and apply accordingly.

Mechanical and electrical (e.g. HVAC) component-sections may require careful thought regarding serviceability loss. Total serviceability loss may occur due to some minor reason (e.g. broken wire, failed switch, etc.) In these situations, the overall component-section condition may be "Green" because perhaps only a minor fix will correct the serviceability problem.

Table 2. Direct Condition Rating Definitions

Rating	**SRM Needs**	**Rating Definition**
Green (+)	Sustainment consisting of possible preventive maintenance (where applicable).	Entire component-section or component-section sample free of observable or known distress.
Green	Sustainment consisting of possible preventive maintenance (where applicable) and minor repairs (corrective maintenance) to possibly few or some subcomponents.	No component-section or sample serviceability* or reliability* reduction. Some, but not all, minor (non-critical) subcomponents may suffer from slight degradation or few major (critical) subcomponents may suffer from slight degradation.
Green (-)		Slight or no serviceability or reliability reduction overall to the component-section or sample. Some, but not all, minor (non-critical) subcomponents may suffer from minor degradation or more than one major (critical) subcomponent may suffer from slight degradation.
Amber (+)	Sustainment or restoration to any of the following: Minor repairs to several subcomponents; or Significant repair, rehabilitation, or replacement of one or more subcomponents, but not enough to encompass the component-section as a whole; or Combinations thereof.	Component-section or sample serviceability or reliability is degraded, but adequate. A very few, major (critical) subcomponents may suffer from moderate deterioration with perhaps a few minor (non-critical) subcomponents suffering from severe deterioration.
Amber		Component-section or sample serviceability or reliability is definitely impaired. Some, but not a majority, major (critical) subcomponents may suffer from moderate deterioration with perhaps many minor (non-critical) subcomponents suffering from severe deterioration.
Amber (-)		Component-section or sample has significant serviceability or reliability loss. Most subcomponents may suffer from moderate degradation or a few major (critical) subcomponents may suffer from severe degradation.
Red (+)	Sustainment or restoration required consisting of major repair, rehabilitation, or replacement to the component-section as a whole.	Significant serviceability or reliability reduction in component–section or sample. A majority of subcomponents are severely degraded and others may have varying degrees of degradation.
Red		Severe serviceability or reliability reduction to the component-section or sample such that it is barely able to perform. Most subcomponents are severely degraded.
Red (-)		Overall component-section degradation is total. Few, if any, subcomponents salvageable. Complete loss of component-section or sample serviceability.

* In this context, evaluating serviceability and reliability is to ask the question, “Since the component-section has one or more purposes for its existence, is it doing what it is supposed to do without disruption?” Certain subcomponent degradation may or may not prevent the component-section from reliably performing as desired. Consider both serviceability and reliability of the component-section and the extent (how many, importance, and magnitude) of subcomponent degradation when rating.

Two-Step Rating Process

The rating process should consist of two steps. The first is the determination of the general “Green,” “Amber,” “Red” rating. Fundamentally, the thought process should be, “Is it Green? – yes or no.” If no, “Is it Red? – yes or no.” If no, it must be Amber. The second step is the possible refinement with a (+) or (-). This thought process should follow, “Is it at the high (+) end? – yes or no.” If no, “Is it at the low (-) end? – yes or no.” If no, there is no (+) or (-) to apply.

CONDUCTING A DIRECT CONDITION RATING INSPECTION WITH BRED

Getting Started

Prior to actually conducting the direct condition rating survey, all planning must be accomplished. The buildings and systems associated with the scheduled component-sections will need to be downloaded to BRED from BUILDER. This topic was discussed in Chapter 1.

Selecting the Component-Section, Direct Rating Option, Sample Location, and Quantity

Referring to Figure 6 the component-section to inspect will be chosen from the tree. The selection may come from the component list or the sample list depending on whether or not sampling is being used. The most recent last inspection date, quantity, and results will be shown as displayed in Figure 14 (no sampling) or Figure 15 (with sampling) if the last inspection was a distress survey. (If the last inspection was a distress survey or if the component-section is painted, the display will look different. Distress surveys were discussed in the previous chapter and paint ratings will be addressed in the next chapter). Other past inspection dates may be chosen from the date drop-down list. From here a new inspection may be made from scratch or made from a copy of past inspection data based on the past date chosen. This is done by pressing either the “New Inspection” or “Copy Inspection” button next to the date field. The current date and component-section quantity will default. If the inspection is new, the direct rating selection radio button should be selected to display the direct rating choices. For new inspections, the quantity will default to the component-section quantity. The actual amount used for a given sample (if sampling is used) will need to be recorded along with the sample location.

Refer to the BRED help file for details on specific operations.

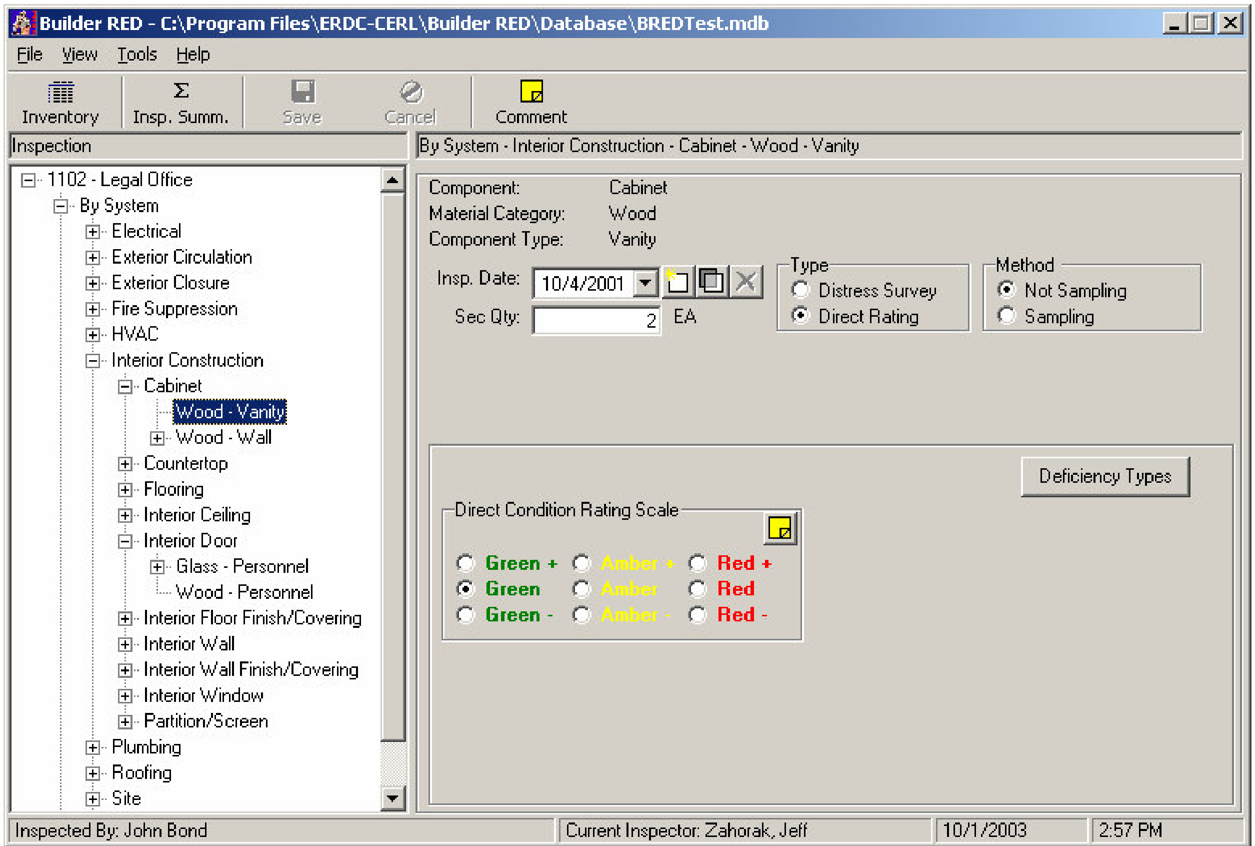

Figure 14. BRED Direct Rating Screen (No Sampling)

Recording Direct Ratings

Referring to Figures 14 and 15, only the appropriate rating button needs to be selected to complete the survey. Keep in mind that the rating applies to the entire component-section or component-section sample. Individual subcomponents are not rated. Particular care must be taken to adhere to the direct rating definitions given in Table 2 and Appendix E and the rating intent described above. When completed, inspect the next sample or repeat for the next component-section.

Copying a Previous Direct Rating

It was stated above that re-inspection of previously defined component-section sample units is STRONGLY recommended. Re-inspecting previously defined sample units permits the inspector to copy the last direct rating into this inspection. The rating can be changed, if necessary, if the inspection findings are different.

To help keep track that all copied sample locations have been re-inspected, the sample location combo box will have a yellow background as illustrated in Figure 16. After all sample locations are re-inspected and saved the background will revert to white thus signaling that all have been re-inspected.

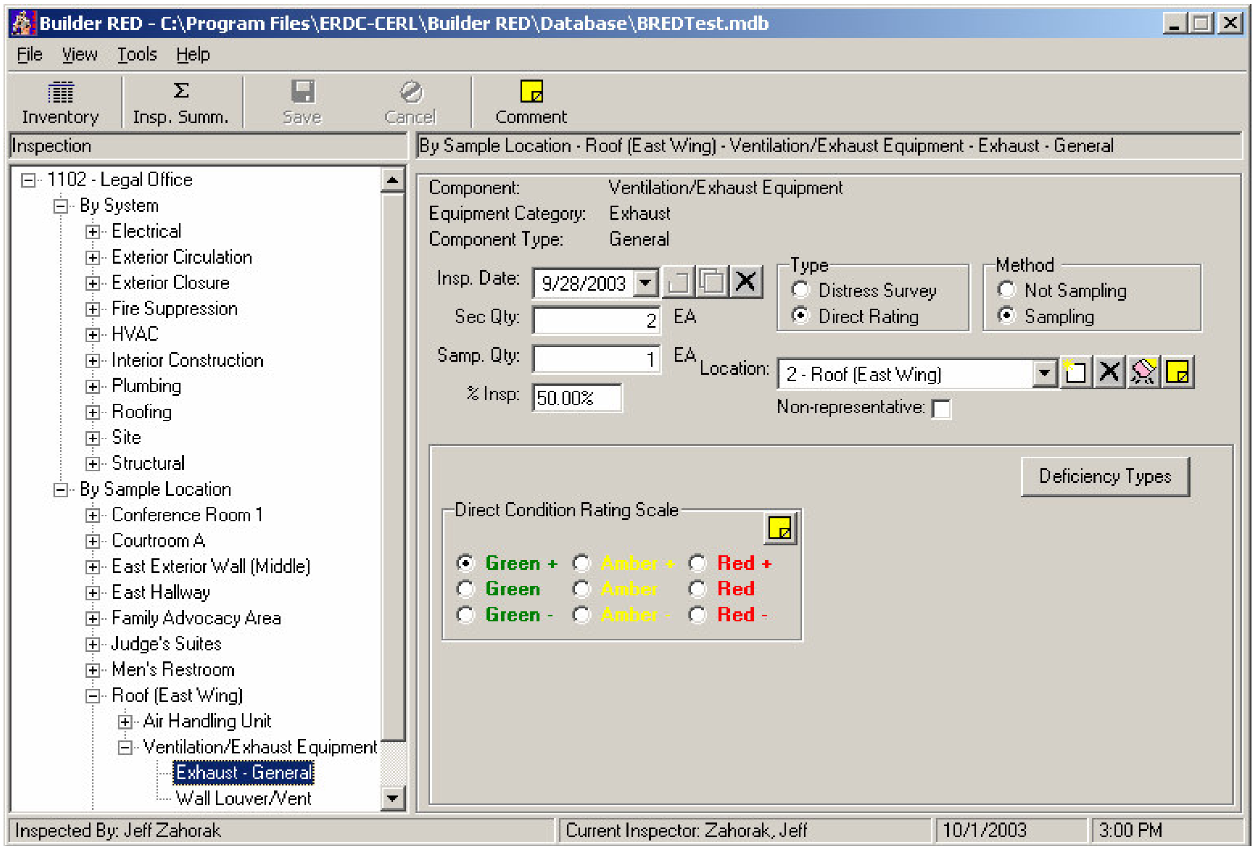

Figure 15. Direct Rating Screen (with Sampling)

RECORDING DIRECT CONDITION RATING DATA WITHOUT BRED

Direct ratings can be accomplished without BRED. The BUILDER set-up compact disk provides sample worksheets that can be used instead of BRED. Revised or custom worksheets can be created or the information can be recorded free form. The key is recording the proper data for later entry into BUILDER.

Without Sampling

For each component-section, record the system, component name, identifying section name (if used, e.g. Roof Section A), material (or equipment) type, and/or component type. These descriptors will uniquely identify the component-section being inspected. Then mark the applicable direct rating. An example of a completed "Direct Rating without Sampling" worksheet is shown below as Figure 17.

With Sampling

For each component-section included in the sample, record the system, component name, identifying section name (if used, e.g. Roof Section A), material (or equipment) type, component type, sample quantity, and whether the sample is representative or not. These descriptors will uniquely identify the component-section being inspected. Then mark the applicable direct rating. An example of a completed "Direct Rating with Sampling" worksheet is shown below as Figure 18.

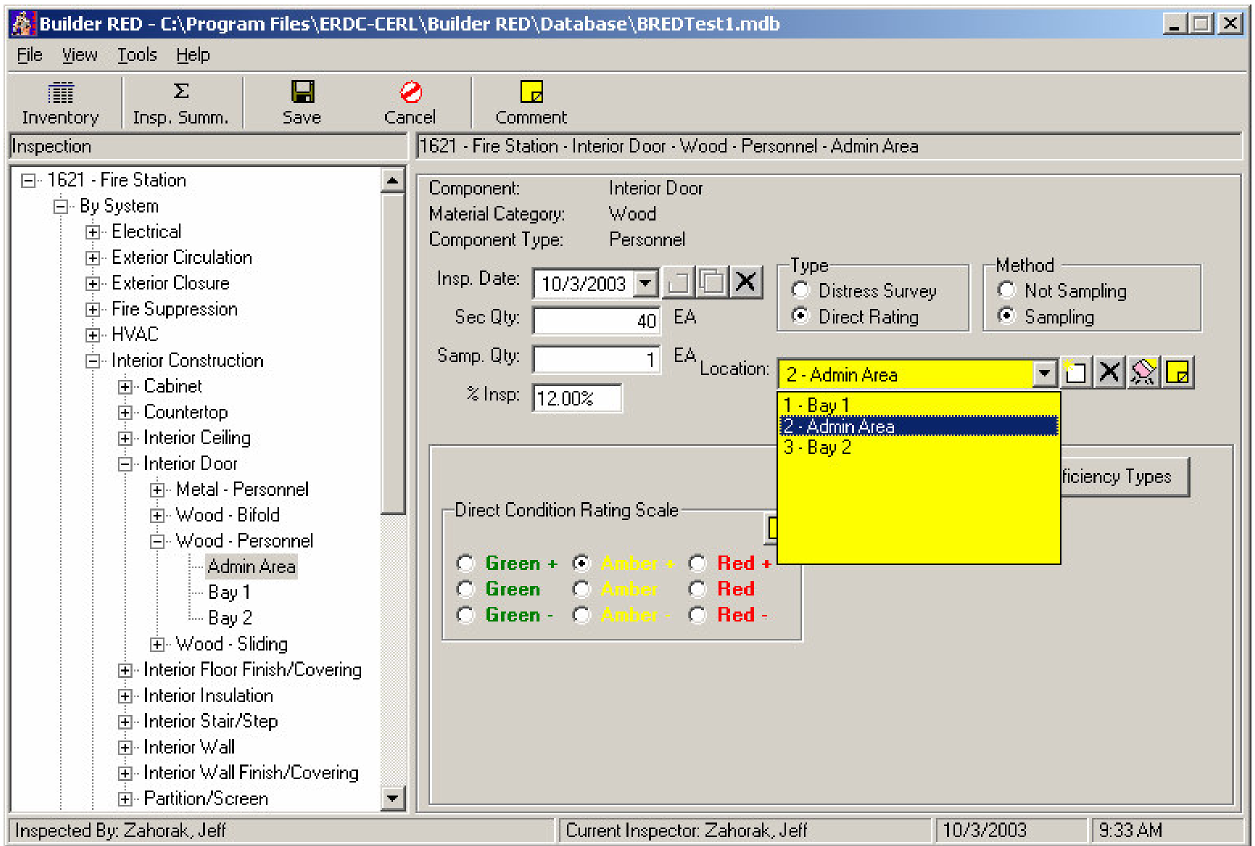

Figure 16. Direct Rating Copy Component-Section Sample Locations Shown in Yellow

BUILDER EMS Direct Component Rating Worksheet
(without Sampling)

Building ID: 328 **Date:** 7/15/98 **Inspector:** Jason M.

System	Component	Section ID	Category/Type	Rating	Paint Rtg
Ext. Circ	Exterior Ramp	None	Concrete /N/A	G-	—
"	Ext. Stair/Step	None	Concrete /Steps	G	—
"	Walkway	none	concrete /Non-elevated	A+	—
Ext. Closure	Exterior Wall	None	Masonry /N/A	G	A+
"	Exterior Door	Exterior	Metal /Personnel	G	G-
"	"	"	Glass / Personnel	G+	—
"	Awning /Canopy	None	Metal /supported	A-	A
"	Exterior Window	Exterior	Metal /Hung	G	G-
"	"	"	Metal /Fixed	A-	R+
"	Fascia	None	Wood /N/A	G-	G-
"	Soffit	None	Wood /N/A	G-	A+
Roofing	Flashing	None	Metal /N/A	G+	—
"	Roof Drainage	None	Metal /Exterior	G	G
"	Roof Surface	None	Metal /Sheet	G	—
Specialties	Special Doors	None	Metal /Vault Door	G	G

Sheet 1 of 1

Figure 17. Example Direct Condition Rating without Sampling Worksheet

BUILDER EMS Direct Component Rating Worksheet
(by Sampling)

Building ID: 113 **Date:** 7/17/98 **Inspector:** Laurence B. **Sample Location:** Men's Room

System	Component	Section ID	Category/Type	Sample Qty	Rep	S#	Rating	Paint Rtg
Int. Const.	Int. Ceiling	1st Floor	Acoustical/suspended	100SF	Y	1	G	
"	Int. Wall Finish	1st Floor	Vinyl/wallpaper	400SF	Y	1	G	
"	Floor Finish	1st Floor	Resilient-Tile	100SF	Y	1	G	
"	Cabinet	1st Floor	Wood /Base	1 EA	Y	1	G	
"	Countertop	1st Floor	laminated Plastic	5 LF	Y	1	G	
"	Partition Screen	1st Floor	laminated Plastic/Toilet Unit	1EA	Y	1	G	
"	"	"	lam. Plastic/ Partition Screen	2EA	Y	1	G-	
Plumbing	Plumbing Equipment	1st Floor	Water Heater/Commercial	1 EA	Y	1	G	
"	Plumbing Fixture	"	Enamel /Urinal	2EA	Y	1	G	
"	"	"	Enamel /Sink (lav)	1 EA	Y	1	G-	
"	"	"	Enamel /Toilet (WaterCloset)	1EA	Y	1	G	
Int. Const.	Int. Door	"	Wood /Personnel	1EA	Y	1	G	G+

Sheet 1 of 1

Figure 18. Example Direct Rating by Sampling Worksheet

4. EVALUATING PAINT/COATING CONDITION

INTRODUCTION

Component-sections that are painted or coated are usually, but not always, evaluated and rated separately from the component-section itself. Paint encompasses the various methods used to preserve the substrate and/or provide aesthetics. Coatings are intended to include such items as varnishes, stains, and water seals and serve the same purposes as paints.

Paint/coating evaluations are based on the direct condition rating approach. Ratings of "Green," "Amber," and "Red" are used along with (+) and (-). This direct approach is used with both distress surveys and direct condition ratings used for the component-sections themselves.

The paint/coating ratings are used to compute a Coating Condition Index (CCI). This index, in turn, is used to adjust the remaining paint/coating life and estimate when the component-section should be re-painted or re-coated.

BUILDER requires that paint inspection be recorded at the same time that the regular component-section inspection is accomplished. Both must be done with the same inspection date.

THE PAINT/COATING RATING DILEMMA (WHEN IS PAINT RATED?)

Just about any component-section may be painted. However, that doesn't necessarily mean that the paint on that component-section should be evaluated separately from the component-section itself.

Generally, paint and coatings will be inventoried and rated when repainting/resealing is an expected recurring work activity. These include such items as resealing a wooden deck, repainting interior walls, and re-varnishing a set of wooden stairs. Inventorying and rating will get these activities triggered and placed on the work plan. When only minor subcomponents are painted (e.g. steel handrails on a set of concrete stairs), the concrete stair component-section will usually not be inventoried as being painted. Any paint problems on the handrail will be considered through the inspection of that subcomponent. It is for that reason why "paint" problems are addressed in some of the distress definitions in Appendix A.

Paint/coatings will only be rated when the component-section is declared "painted/coated" in the BUILDER inventory. BUILDER inventory procedures address when a component-section is considered painted (or coated). Fundamentally, there are two factors to consider when deciding when paint/coatings will be inventoried. The first is the significance of the paint/coating to the component-section as a whole. Some component-sections consist of two or more subcomponents of which not all may be painted. Those subcomponents that are painted may be but a small portion of the overall component-section. Second, many component-section subcomponents have “factory” applied paint finishes. Generally, these are applied to preserve the subcomponent and are rarely painted on a periodic basis. Thus, the paint life is often the component-section life.

PAINT/COATING RATING DEFINITIONS

The paint rating definitions are based on a combination of deterioration and density. The direct rating approach consists of three broad categories (nine total categories defined by the “% Deteriorated”) described as "Green," "Amber," and "Red." “Green” implies that the paint or coating is suffering little, if any, serviceability loss due to degradation, and some sustainment (touch up painting) may be needed, but not significant enough to place on a corrective maintenance work plan. This is reflected in the small “% Deteriorated.” “Red” implies serious serviceability problems due to degradation and significant repainting or recoating (usually to the entire component-section or component-section sample) is needed. As can be seen, relatively low percentages of deterioration warrant significant repainting or recoating. This is primarily due to aesthetics. “Amber” (or yellow) ratings represent the middle and suggest that repainting or recoating is needed soon.

The definitions are listed in Table 3, below and are repeated in Appendix E for ready reference.

Table 3. Paint/Coating Rating Criteria

Rating	**% Deteriorated**	**Relative Amount Deteriorated**
Green (+)	0.00 – 0.03	Up to about 1”x 4” in a 8’x 10’ area; 1/32” in a 10’ length; or 3 in 10,000
Green	0.03 – 0.10	Between about 1”x 4” and 1”x 12” in a 8’x 10’ area; 1/32” and ⅛” in a 10’ length; or 3 and 10 in 10,000
Green (-)	0.10 – 0.30	Between 1”x 12” and 3”x 12” in a 8’x 10’ area; ⅛” and ⅜” in a 10’ length, or 1 and 3 in 1000
Amber (+)	0.30 – 1.00	Between 3”x 12” and 10”x 12” in a 8’x 10’ area; ⅜” and 1¼” in a 10’ length; or 3 and 10 in 1000
Amber	1.00 – 3.00	Between 10”x 12” and 18”x 18” in a 8’x 10’ area; 1¼” and 3¾” in a 10’ length; or 1 and 3 in 100
Amber (-)	3.00 – 10.0	Between 1’x 2½’ and 1’x 8’ in a 8’x 10’ area; 3¾” and 12” in a 10’ length; or 3 and 10 in 100
Red (+)	10.0 – 17.0	Between 1’x 8’ and 1¾’x 8’ in a 8’x 10’ area; 1’ and 1¾’in a 10’ length; or 10 and 17 in 100
Red	17.0 – 33.0	Between 1¾’x 8’ and 3⅓’x 8’ in a 8’x 10’ area; 1¾’ and 3⅓’ in a 10’ length; or 17 and 33 in 100
Red (-)	33.0 - 100	Greater than 1/3 of area, length, or amount

PAINT/COATING RATING PROCEDURES

Distress Survey

When performing a distress survey, each painted/coated subcomponent shall also be rated. This is shown in Figure 19 if BRED is used. (Note: the screen is slightly different if sampling is used, but it is not shown here for brevity). The applicable rating will be chosen from the paint rating drop-down list. Any subcomponents not painted will not have a rating. Recall from Figure 8 that if the component-section is not inventoried as painted/coated, the paint/coating portion of the screen is not visible. In those cases and when certain subcomponents are painted the paint will be evaluated as part of the subcomponent distress.

If a distress survey is being copied for re-inspection (see Chapter 2), the paint ratings copy over as well.

If BRED is not used, each subcomponent needs to be appropriately marked as shown in Figures 12 (no sampling) and 13 (with sampling).

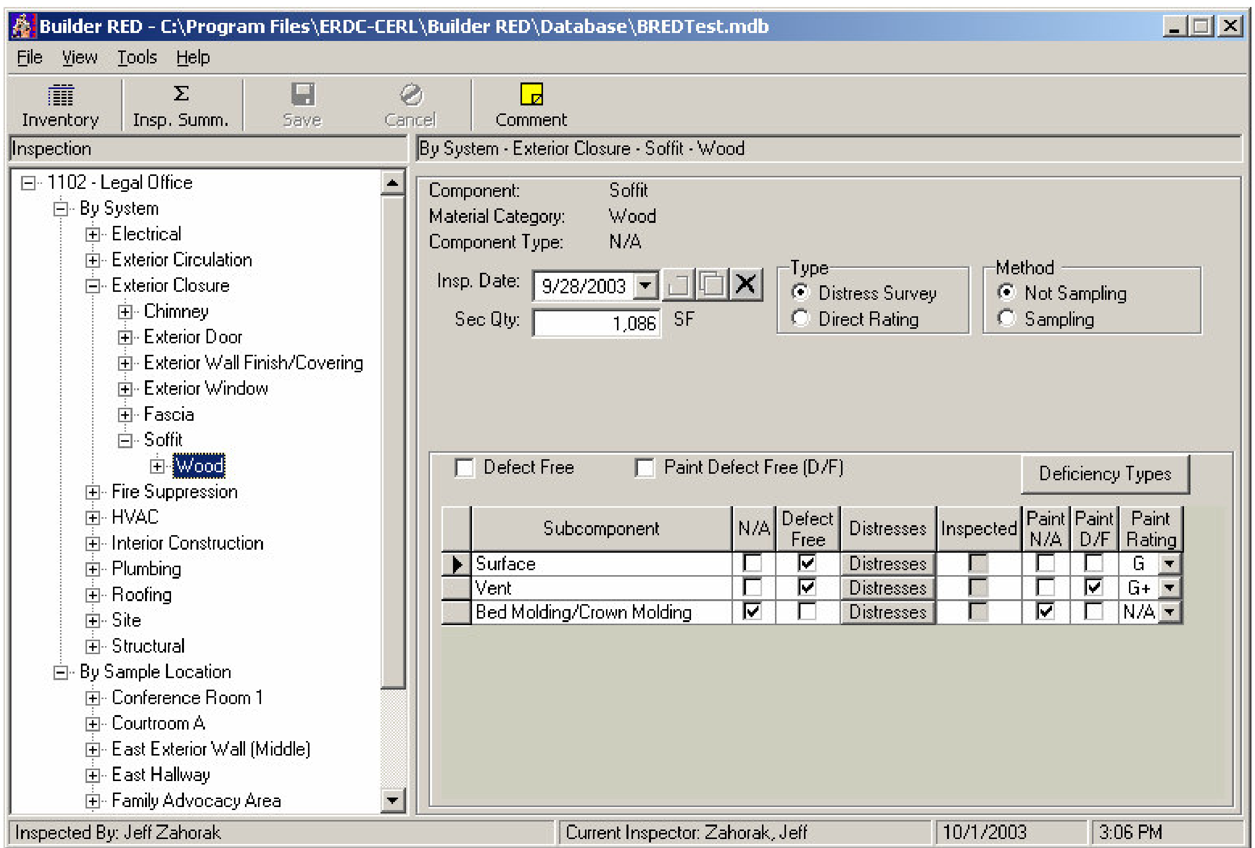

Figure 19. Distress Survey Screen When Component-Section Painted/Coated

Direct Condition Rating

When performing a direct condition rating, evaluate the component-section paint or coating in its entirety. The "% Deteriorated" is to be based on the painted portions only. Refer to Figure 20 for marking paint ratings in BRED. (Note: the screen is slightly different if sampling is not used, but it is not shown here for brevity). Recall from Figure 14 that if the component-section is not inventoried as painted/coated, the paint/coating portion of the screen is not visible. In those cases and when certain subcomponents are painted the paint will be evaluated as part of the overall component-section rating.

If a direct rating is being copied for re-inspection (see Chapter 3), the paint ratings copy over as well.

If BRED is not used, the paint rating is recorded as shown in Figures 17 (no sampling) and 18 (with sampling).

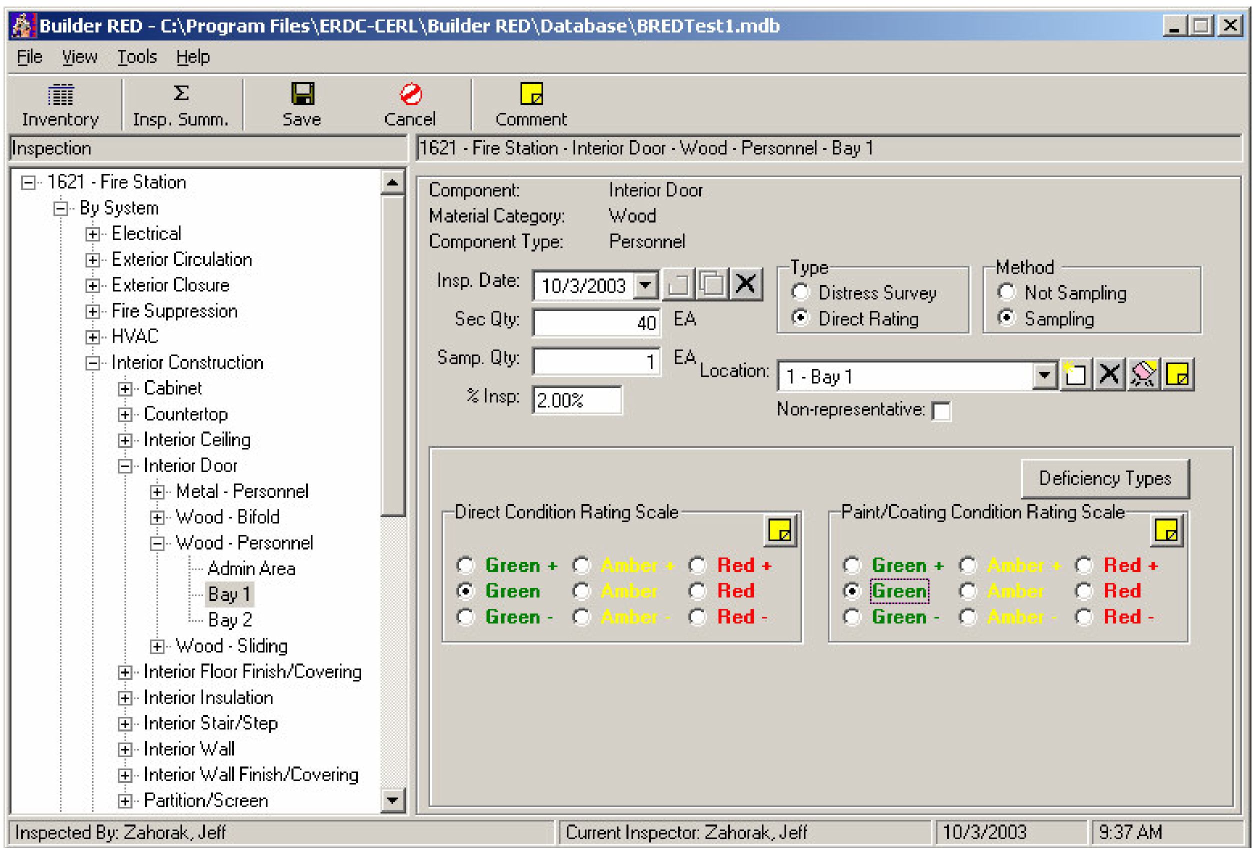

Figure 20. Direct Rating Screen When Component-Section Painted/Coated

APPENDIX A – DISTRESS SURVEY DEFINITIONS

General Notes

1) These distresses are intended to apply generically to all subcomponents that collectively form building component-sections.

2) Structural component-sections and subcomponents must be viewed from a loss of structural integrity perspective. A severity level of *High* must be recorded should the presence of any distress type compromise the structural integrity of the component-section or subcomponent.

3) *High* severity must be recorded for any distress type, regardless of density, that is resulting in an unacceptable health, life/safety, or security risk.

4) There are two general rules. One, if a certain distress type is a special case of another distress type, only record the special case. Two, if a certain distress type results from the existence of another distress, record both. Pay particular attention to the notes provided for each distress definition. They often address the application of these rules.

5) Where multiple severity levels are present for a given distress type on a given subcomponent, record each separately with the appropriate amount or density, unless stated otherwise for a given distress type. The total amount or density for all severity levels cannot exceed 100%.

6) Distress quantities or distress density may be recorded. If distress quantities are recorded, density ranges will be computed in BUILDER/BRED. If distress densities are recorded, distress quantities will be blank in BUILDER/BRED.

7) Some of the distress definitions described herein make note of a "replacement unit." Certain component-sections are a collection of units. Examples of this are tiles (ceiling, floor, etc.). If the logical work action for these units is to replace some or all of them (e.g. a cracked ceiling tile will be replaced), then the distress quantity and/or density should reflect the area, length, or quantity of the distressed units rather than the distress itself.

8) If during the course of the inspection additional occurrences are found of distress-severity combinations for a given component-section subcomponent or subcomponent sample (if sampling), adjust the distress quantity or distress density as necessary.

9) Density ranges, when recorded instead of distress quantities, can be estimated as described in Table A1.

Table A1. Distress Density Estimation Visual Cues

Density (%)	Visual Cue (when applicable)
>0-0.1%	Difficult to notice even by careful observation, especially if spotty. (up to about 1"x 12" in a 8'x 10' area; ⅛" in 10' length; or 1 in 1000)
>0.1-1%	Somewhat noticeable, but easily missed by casual observation, especially if spotty; Careful observation usually needed, if spotty. (up to about 10"x 12" in a 8'x 10' area; 1¼" in 10' length; or 1 in 100)
>1-5%	Noticeable, even by casual observation, but still only a mere fraction. (up to about 1'x 4' in a 8'x 10' area; 6" in 10' length; or 1 in 20)
>5-10%	Easily noticeable even if spotty; more than a mere fraction. (up to about 1'x 8' in a 8'x 10' area; 1' in 10' length; or 1 in 10)
>10-25%	Readily noticeable, but less than ¼ of area, length, or amount.
>25-50%	Very noticeable, but less than ½ of area, length, or amount.
>50-<100%	Overwhelmingly noticeable; greater than ½ of area, length, or amount.
100%	Entire area, length, or amount.

10) Some subcomponents have a unit of measure of "Each." Distress densities may apply to the entire unit or a unit portion as indicated in the definitions below. Density must first be applied to an entire unit and then applied across multiple units, if present. For example, if a fan belt has been chewed by a rodent, the distress density for that unit would be 100% regardless of how much of the belt has been chewed because the belt as a whole is adversely affected. But if there are three belts present and the other two are free of that same distress, the density will drop to 33%.

11) Distresses for built-up, single-ply, and asphalt shingle roofing (membrane, flashing, etc.) shall follow the ROOFER EMS definitions provided in Appendices B through D. Densities may be estimated or distress quantities may be recorded.

Distress Summary Listing

1. Animal/Insect Damaged
2. Blistered
3. Broken
4. Capability/Capacity Deficient
5. Clogged
6. Corroded
7. Cracked
8. Damaged
9. Deteriorated
10. Displaced
11. Efflorescence
12. Electrical Ground Inadequate or Unintentional
13. Holes
14. Leaks
15. Loose
16. Missing
17. Moisture/Debris/Mold Contaminated
18. Noise/Vibration Excessive
19. Operationally Impaired
20. Overheated
21. Patched
22. Rotten
23. Stained/Dirty

Animal/Insect Damaged

Definition: Subcomponent has been gnawed, chewed, scratched, bitten, or otherwise damaged by animals, birds, and/or insects. Evidence includes holes, droppings, nests, sawdust, shavings, and particle matter indicating the presence of animals, birds, and/or insects.

Notes:
1) Nests, per se, may not indicate animal/insect damage, but indicate the past or a current presence of animals, birds, or insects. Nests should be recorded under "Moisture/Debris/Mold Contaminated".
2) Damage may be internal. Therefore, if clues indicate animal, bird, or insect damage, the subcomponent should be sounded with a hammer or mallet. A hollow sound may indicate internal damage.
3) If damage includes staining, record "Stained" in addition to "Animal/Insect Damaged." If the only damage is staining, only record "Stained" and do not record "Animal/Insect Damaged."
4) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the animal/insect damage a leak has also occurred, record the severity level as *High* and the distress type "Leaks," as well.
5) If the animals, birds, or insects causing the damage are still present, record as *High* severity.
6) If the subcomponent unit-of-measure is "Each," estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes).
7) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and animal/insect damage has occurred to subcomponents where the logical repair would be the replacement of a unit (e.g. wood deck member, fan belt) the measurement quantity will be that entire unit even though the animal/insect damage may only encompass portion of that unit. If the subcomponent can be patched, the measurement quantity will only encompass the area to be potentially patched.
8) Assign only one severity level to a given logical replacement area, length, or quantity measured as described in 7) above.

Severity Levels:

Low - Distress exists, but damage is superficial.

Medium - Distress exists, but not superficial, nor raised to the level of *High*.

High - Any of the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The passage of animals, birds, or insects is possible and/or likely, but prevention is required.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Termite damage
- Pet scratches
- Rodent holes
- Fecal contamination
- Carpenter bee holes
- Animal pathways in insulation
- Screen in roof ventilator displaced and holed by animal in order to gain access to attic
- Bent roof ventilator blade caused by animal gaining access to attic
- Animal hole under security fence

Blistered

Definition: Round or elongated raised areas of the subcomponent surface that are generally filled with air.

Note: "Blistered" is a special case of deterioration. When present, record "Blistered" instead of "Deteriorated."

Severity Levels:

Low - The raised areas are noticeable by vision or touch.

Medium - Blistered area has begun to show deterioration.

High - Blisters are broken or worn through.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Floor covering with raised area that is "soft" when walked on
- Wall covering (wallpaper) with air pocket

Broken

Definition: Subcomponent has been fractured, shattered, or otherwise separated into two or more pieces and one or more of those pieces are missing or if the pieces are all present the separation is resulting in the loss of operability to this or other subcomponents.

Notes:
1) Care must be taken to differentiate between "Broken," "Cracked," "Damaged," "Operationally Impaired," and "Missing." The differentiation between "Broken" and "Cracked" are the missing pieces or loss of operability associated with "Broken." "Broken" provides greater problem specificity and should be used instead of "Damaged," when applicable. "Operationally Impaired" should be recorded instead of "Broken" if operability is lost, but there is no true separation of pieces or if a separation is unknown. Missing pieces as a result of fracturing denotes "Broken," whereas missing parts without fracturing denotes "Missing."
2) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the fracturing a leak has occurred, record the severity level as *High* and the distress type "Leaks," as well.
3) If the subcomponent unit-of-measure is "Each" estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes #10).
4) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and the logical repair would be the replacement of a unit (e.g. ceiling tile, window pane, etc.) the measurement quantity will be that entire unit even though the actual broken quantity may only encompass a portion of that unit. If the subcomponent can be patched, the measurement quantity will only encompass the area to be potentially patched.
5) Assign only one severity level to a given logical repair or replacement area, length, or quantity measured as described in 4) above.

Severity Levels:

Medium - Distress exists.

High - Any of the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Shattered window pane
- Wire separated from connector preventing lights from working
- Ceiling tile separated into two pieces with the one piece missing

Capability/Capacity Deficient

Definition: Component serviceability is lacking due to insufficient capacity, technical obsolescence, or lack of compliance to applicable codes. This can be due to poor original design, alterations, changes in component demand, and/or changes in building use.

Notes:
1) Capability/Capability Deficient" is defined at the component level, but sometimes it is apparent at the system level (e.g. HVAC) or in a building functional area (e.g. kitchen). However, since inspection is performed on component-sections at the subcomponent level, "Capability/Capacity Deficient" should be applied to all applicable subcomponents in their parent component-sections. Building functional areas may need to be identified and used as basis for creating component-sections to get the proper assignment of this distress.
2) Consider "Capability/Capacity Deficient" in a broad context (e.g. meeting Americans with Disabilities Act (ADA) requirements, building use demands, etc.)
3) Only rate component-sections actually present in the building, not those that may be required but never installed or constructed.
4) Check for problems with other components/subcomponents to ensure that other, more appropriate, distress types are not the true cause of the perceived deficiency.
5) This distress will be eliminated in a future version of BUILDER. Component-section functionality metrics are under development and when completed this distress will be superseded by those in a functionality assessment procedure.

Severity Levels:

Low - Distress exists, but superficial. Mission or quality-of-life rarely affected.

Medium - Distress exists, but not superficial, nor raised to the level of *High*.

High - Any of the following exists:
- Health, life/safety, security, or structural integrity problems.
- Violation of law.
- Adversely affects mission or quality-of-life for an extended period of time.

Measurement: Affected Area, Length, or Quantity

Density: $\frac{A}{B} \times 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- HVAC ductwork does not extend into an office
- HVAC unit size too small for cooling demand
- Furnace cannot adequately heat office in winter
- Pipe size too small for proper water flow
- Wheelchair ramp too steep
- Poor room lighting
- Door undersized for a wheelchair

Clogged

Definition: Obstruction within a subcomponent that is disrupting the intended flow of air, other gasses, or liquids.

Notes:
1) "Clogged" applies to such items as pipes, drains, valves, ducts, troughs, gutters, filters, screens, heating/cooling coils, and other "enclosed (totally or partially)" subcomponents used to channel liquids and/or gasses.
2) The measurement amount and density are based on the subcomponent length, area, or quantity, not on the degree of blockage for that amount. The degree of blockage is used to determine severity level.
3) Sometimes, the extent of a clogged item is unknown (e.g. how much of a length of pipe is clogged?). If unknown, estimate a reasonable amount or density of the subcomponent length or area.
4) If blockage is due to corrosion, debris or vegetation, or dirt, record the distress type "Corroded," "Moisture/Debris/Mold Contaminated, " or "Stained/Dirty," respectively, in addition to "Clogged." If those distresses are present, but the flow is unaffected, do not record, "Clogged."

Severity Levels:

Low - Distress exists, but blockage is superficial.

Medium - Distress exists, but not superficial, nor raised to the level of *High*.

High - Any of the following exists:
- Health, life/safety, or security problems.
- Flow is severely restricted.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate.

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Waste water pipe that will not drain or drains slowly
- Downspout with little flow and water spilling over gutter
- Low water flow from faucet (not due to low water pressure)
- Reduced air flow from duct due to presence of foreign matter

Corroded

Definition: Subcomponent is wearing away, disintegrating, flaking, lensing, and/or scaling due to the effects of chemical, electrochemical, or electrolytic attack.

Notes:
1) "Corroded" is a special case of deterioration. When present, record "Corroded" instead of "Deteriorated."
2) Any staining of the surrounding area (e.g. rust streaks) will also be recorded as "Stained."
3) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the corroding a leak has also occurred, record the severity level as *High* and the distress type "Leaks," as well.
4) Record "Clogged," in addition if corrosion is causing clogging.
5) Paints and coatings that are failing to provide a protective coating, but NOT inventoried with the subcomponent, are included in the "Corroded" distress type at *Low* severity. Paints and coatings, inventoried with the subcomponent, that are failing to protect the subcomponent shall be given a separate paint/coating rating.
6) Do not record *Low* severity levels for paint or coatings and higher severity levels for the subcomponent at the same locations.
7) If the unit-of-measure of the subcomponent is "Each," estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes #10).
8) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and corrosion has occurred to subcomponents where the logical repair would be the replacement of a unit (e.g. metal panel) the measurement quantity will be that entire unit even though the corrosion may only encompass portion of that unit. If the subcomponent can be patched, the measurement quantity will only encompass the area to be potentially patched.
9) Assign only one severity level to a given logical replacement area, length, or quantity measured as described in 8) above.
10) If the corrosion is desirable (e.g. patina on copper), "Corroded" will not be recorded.

Severity Levels:

Low - Any of the following exists:

- Corrosion exists, but can usually be brushed off.
- Deterioration superficial.
- Paint or protective coating (e.g. PVC) has failed and corrosion has begun (only when paint is not rated separately).

Medium - Flaking, lensing, and/or scaling exist, but not raised to the level of *High*.

High - Any of the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Spotty brown rust on metal roofs
- Brown water from internal pipe corrosion
- Rusty pipe supports
- Failure of the galvanized coating on a corrugated steel sheet wall

Cracked

Definition: Subcomponent has been fractured. Separation into two or more pieces may or may not have occurred. Crack width may be variable and faulting may be present. There is no loss of operability to the subcomponent or component-section.

Notes:
1) A hairline crack is defined as having a width so small as to be very tight.
2) Care must be taken to differentiate between "Cracked," "Broken," "Damaged," and "Deteriorated." "Cracked" implies that the fractured pieces are intact, whereas "Broken" implies that some of the resulting cracked pieces are missing or a loss of operability. Fracturing may possibly be caused by a specific event which suggests the distress type "Damaged." However, record as "Cracked." Likewise, fracturing can occur as a consequence of weathering, humidity change, and sustained or repeated loading over long periods suggesting "Deteriorated." However, record "Cracked."
3) "Cracked" and the distress types "Broken" and/or "Damaged" can occur together in the same subcomponent-section, but only independently at different locations (e.g. different ceiling tiles in the same component-section).
4) If the fractured pieces are faulted, record the distress type "Displaced" also.
5) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the crack a leak has occurred, record the severity level as *High* and the distress type "Leaks," also.
6) Density is determined from dividing total crack length by the subcomponent surface area or length, as appropriate.
7) If the subcomponent unit-of-measure is "Each" estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes #10). If multiple cracks exist at different severity levels, record at the highest level.
8) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and cracking has occurred in subcomponents where the logical repair would be the replacement of a unit (e.g. ceiling tile, window pane, pipe section, etc.) the measurement quantity will be that entire unit even though the actual crack may only encompass portion of that unit. If the subcomponent can be patched, the measurement quantity will only encompass the area to be potentially patched.
9) Assign only one severity level to a given logical replacement area, length, or quantity measured as described in 8) above.

Severity Levels:

Low - Hairline cracks which may or may not divide the subcomponent into pieces. If distinct pieces exist, they are held tightly together.

Medium - Crack width greater than hairline and the subcomponent has been divided into pieces with clear separation, but not raised to the level of *High*.

High - Any if the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate.

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Fractured sidewalk, masonry wall, window, or ceiling tile with all pieces present
- Fractured pipe from frozen water

Damaged

Definition: Dents, chips, gouges, tears, rips, distortion, rupture, etc. resulting from impact (e.g. vehicles), fire, flood, or other means associated with specific events.

Notes:
1) Care must be taken to differentiate between "Damaged," "Animal/Insect Damage," "Broken," "Cracked," and "Moisture/Debris/Mold Contaminated." Those other distress types imply a greater specificity and should be recorded, if applicable, instead of "Damaged."
2) "Damaged," "Animal/Insect Damage," "Broken," "Cracked," and/or "Moisture/Debris/Mold Contaminated" can occur within the same subcomponent, but only independently at different locations (e.g. different locations on the same wall.)
3) If displacement has occurred along with the damage, record the distress type "Displaced" also. If the damage event has only resulted in a displacement, record "Displaced" instead of "Damaged."
4) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the specific damage event a leak has occurred, record the severity level as *High* and the distress type "Leaks," also.
5) If the subcomponent unit-of-measure is "Each" estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes #10).
6) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and damage has occurred to subcomponents where the logical repair would be the replacement of a unit (e.g. ceiling tile, window pane, pipe section, etc.) the measurement quantity will be that entire unit even though the actual damage may only encompass portion of that unit. If the subcomponent can be patched, the measurement quantity will only encompass the area to be potentially patched.
7) Assign only one severity level to a given logical replacement area, length, or quantity measured as described in 6) above.
8) If the damage is the result of liquids other than water (e.g. oil), record "Damaged" and clarify with a comment.
9) Tiny isolated dents, chips and gouges at extremely low density (difficult to see or even find) should not be recorded.

Severity Levels:

Low - Distress exists, but superficial.

Medium - Distress exists, but not superficial, nor raised to the level of *High*.

High - Any of the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Dent in metal column from collision with forklift
- Dent and hole in metal wall from impact of a forklift tine
- Scratches and chips in masonry wall from vehicle impact
- Dents in gutters from ladders
- Gouges in walls from abuse
- Deformation of roof from flying debris or hail
- Scratched, chipped, frayed, and/or holed ceiling tile from poor handling
- Hole in wall from hammer
- Carpeted wall torn from snag with passing sharp or pointed object
- Wall corner gouged or distorted from collision with a heavy object
- Charred wood column from fire

Deteriorated

Definition: The natural degradation of the subcomponent through normal usage and/or environmental exposure. This may involve disintegration, erosion, delamination, weathering, checks, warps, bumps, raveling, flaking, pitting, spalling, wear, etc. and/or a change in properties (e.g. brittle). Included are a wearing away and/or thinning of coatings (e.g. paint, varnish, polyvinyl (PVC), etc.)

Notes:

1) "Corroded" and "Rotted" are special cases of "Deteriorated." When they are present, they should be recorded instead of "Deteriorated." Sometimes, "Cracked" and "Moisture/Debris/Mold Contaminated" may be a special case of "Deteriorated." Record the distress type "Cracked" or "Moisture/Debris/Mold Contaminated" instead of the distress type "Deteriorated" when cracks or contamination are present, respectively.
2) If displacement is occurring along with the natural degradation, record the distress type "Displaced," as well.
3) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the degradation a leak has occurred, record the severity level as *High* and the distress type "Leaks," also.
4) Paints and coatings that are degraded, but NOT inventoried with the subcomponent, are included in the "Deteriorated" distress type at *Low* severity. Paints and coatings, inventoried with the subcomponent, that are degraded shall be given a separate paint/coating rating.
5) Do not record *Low* severity levels for paint or coatings and higher severity levels for the subcomponent at the same locations.
6) If the subcomponent unit-of-measure is "Each" estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes #10).
7) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and deterioration has occurred to subcomponents where the logical repair would be the replacement of a unit (e.g. ceiling tile, door, wood cladding sheet, etc.) the measurement quantity will be that entire unit even though the actual deterioration may only encompass a portion of that unit. If the subcomponent can be patched, the measurement quantity will only encompass the area to be potentially patched.
8) Assign only one severity level to a given logical replacement area, length, or quantity measured as described in 7) above.

Severity Levels:

Low - Either of the following exists:

- Distress exists, but superficial.
- Painted or coated surface worn, chipped, blistered, etc. (only when the paint is not being rated separately.)

Medium - Distress exists, but not superficial, nor raised to the level of *High*.

High - Any of the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals or birds (and possibly insects) is possible and/or likely.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Delamination of brick faces
- Splits in wood members
- Brittle and cracked caulking
- Worn or raveled carpeting
- Warped flooring
- Peeling wallpaper
- Spalled concrete
- Weathered wood deck

Displaced

Definition: Subcomponent has been moved, deflected, shifted, bulged, rotated, faulted, or settled from its intended position. This may be due to a specific event (e.g. earthquake, collision, failure of another subcomponent, etc.), plastic deformation, or consolidation over time.

Notes:
1) "Displaced" is a special case of either "Damaged" or "Deteriorated." It can be used together or separately from them. This should be used together with "Damaged" only when the subcomponent has been shifted from its normal position and the subcomponent is otherwise damaged. Distortion of the subcomponent either through being damaged or deteriorated does not, in itself, constitute being displaced. If the specific event causing the movement resulted in no other damage, record "Displaced" not "Damaged."
2) "Displaced" should be used together with "Deteriorated" if one or more subcomponent parts have moved and the distress type "Deteriorated," is apparent also.
3) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the displacement a leak has occurred, record the severity level as *High* and the distress type "Leaks," also.
4) Where displacement has resulted in cracking or vice versa, record the distress type "Cracked," as well.
5) A loose subcomponent may sag due to its weight. In these cases, record "Loose" instead of "Displaced."
6) "Displaced" may possibly occur to an entire component-section or to a subcomponent with other subcomponents attached to it. If so, record first to the primary subcomponent. Then, only record for other subcomponents if they have moved relative to the primary subcomponent.

Severity Levels:

Low - Distress exists, but magnitude of movement is slight.

Medium - Distress exists, but not slight, nor raised to the level of *High*.

High - Any of the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate.

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Leaning chimney or flue
- Uneven sidewalk
- Parapet movement
- Steps separated from building
- Sagging roof truss
- Dislodged door frame
- Open seams or joints in ductwork or gutters
- Light pole leaning after hit by truck
- Bulge in masonry wall resulting from brick unit expansion from moisture
- Floor with excessive deflection
- Sagging ceiling tiles
- Column out-of-plumb

Efflorescence

Definition: Soluble salts encrusted on the surface of masonry, concrete, or plaster subcomponents caused by moisture leaching free alkalies from mortar or concrete. Efflorescence is typically seen as a white powdery coating.

Severity Levels:

Low - Coating is noticeable and easily brushed off, but the surface is visible.

Medium - Either of the following exists:
- Coating is not easily brushed off.
- Surface is obscured.

Measurement: Affected Area, Length, or Quantity

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Example: White powder on brick or concrete masonry

Electrical Ground Inadequate or Unintentional

Definition: Unintentional connection of very low resistance causing a short circuit or a high resistance connection resulting in inadequate grounding.

Notes:
1) "Electrical Ground Inadequate or Unintentional" is a special case of impaired operations. When present, record "Electrical Ground Inadequate or Unintentional" instead of "Operationally Impaired."
2) Record additional distress types, if known, should they be contributing to this distress. These may include "Corroded," "Loose," "Damaged," etc.

Severity Levels:

High - Distress exists.

Measurement: Total Subcomponent Area, Length, or Quantity

Density: 100% (automatic)

Distress Examples:

- Lightning arrestor disconnected or broken
- Connector insulated by paint
- Open or no ground at outlet for interior wiring

Holes

Definition: Drilling, punching or penetration of a subcomponent for an intended purpose. Penetration depth may be partial or complete.

Notes:
1) Do not record "Holes" along with the distress types "Animal/Insect Damaged," "Broken," "Corroded," "Damaged," "Deteriorated," "Missing," or "Rotten." The presence of holes determines the severity levels for those distress types.
2) Do not record if holes are not in plain view or do not degrade the subcomponent.
3) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the penetration a leak has occurred, record the severity level as *High* and the distress type "Leaks," as well.
4) Holes resulting from missing fasteners shall not be recorded if the fastener should be replaced. Record "Missing" for the fasteners instead.
5) Do not count pinholes, unless density is sufficient to be noticeable or a leak has occurred.
6) Clusters of *Low* severity holes within one (1) square foot (0.1 square meter) shall count as one (1) *Medium* severity hole.
7) Weep holes shall not be recorded.

Severity Levels:

Low - Partial depth penetration.

Medium - Either of the following:
- Clusters of *Low* severity holes.
- Distress exists, but not raised to the level of *High*.

High - Any of the following exists:
- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The penetration is adversely affecting the operation of another subcomponent, the parent component-section, or another component-section.
- The subcomponent is unusable.

Measurement: Number of Holes

Density: $\frac{A}{B} \times 100$ = Problem Density

Where: A = Number of Holes
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Pipe penetration that is not sealed
- Former anchor holes for signs since removed
- Permanently secured door with door lock removed, but hole for lock remains

Leaks

Definition: The unwanted entry, passage, or escape of gas or liquid.

Notes:
1) If the leaking gas or liquid is a biological (e.g. herbicide, pesticide, etc.), chemical (e.g. volatile, flammable, explosive, corrosive, etc.), or radioactive hazard, *High* severity shall be recorded. Also, notify for immediate corrective action.
2) "Leaks" may be recorded without any other distresses.
3) Do not record "Leaks" in conjunction with "Animal/Insect Damaged," "Broken," "Corroded," "Cracked," "Damaged," "Deteriorated," "Displaced," "Holes," "Loose," "Missing," or "Rotten" unless the subcomponent is a tank, pipe, container, trough, pressure vessel or sealant. The loss of liquids or gas (or the gain from a vacuum loss) from those subcomponents as a result of those distresses is the trigger for "Leaks."
4) Leaks from cracks, joints, etc. should be measured as the crack or joint length, etc.

Severity Levels:

Low - Distress exists, but superficial.

Medium - Distress exists, but not raised to the level of *High.*

High - Any of the following exists:

- Health, life/safety, or security problems.
- Steady rate of flow and loss of air, gas, water, or other liquid of significant concern.
- Pressure or vacuum loss apparent and adversely affecting usage.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the leakage.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- Overall component-section, component, or system usage is adversely affected by liquid or gas loss.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Water dripping from hot water heater or pipe connection
- Air escaping from compressed air line
- Boiler tubes dripping water into firebox
- Water dripping from rain gutter
- Leaky faucet
- Loss of seal in a thermopane window causing the window to fog
- Water entering during a storm through failed sealant joint between window and wall

Loose

Definition: Subcomponent or subcomponent parts are not secured tightly to one or more other subcomponents. Also, one or more fasteners (i.e. bolts, screws, pins, nails and/or rivets) are not tight (torqued to a proper tension).

Notes:
1) If subcomponent is loose due to being "Broken" or "Damaged" do not report "Loose."
2) Fasteners are not considered subcomponents. If any fasteners are loose, record the subcomponent being fastened as "Loose" at *Low* severity. Estimate density based on the number of similar fasteners needed.
3) If the entire subcomponent is loose, record with a density of 100% at either *Medium* or *High* severity, as applicable. Any missing fasteners should be recorded as "Missing."
4) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of being loose a leak has occurred, record the severity level as *High* and the distress type "Leaks," as well.
5) Subcomponents firmly attached to a loose subcomponent are not loose.

Severity Levels:

Low - Fasteners are loose, but subcomponent is tight.

Medium - Subcomponent is loose, but not raised to the level of *High.*

High - Any of the following exists:
- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate.

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Loose bolts holding light fixture to wall
- Roof or wall panels flapping in wind
- Non-secured stair railing
- Slackened guy wire
- Squeaky floor or stair when walked or stepped on
- Nail or screws popping out of drywall panel
- Raised nails or screws in a deck or flooring

Missing

Definition: Subcomponent and/or subcomponent parts including fasteners (i.e. bolts, screws, pins, nails and/or rivets) are required, but absent due to removal, dislodgement, or deterioration.

Notes:
1) If a subcomponent or subcomponent parts are missing resulting in a hole, record "Missing." Do not record "Holes" for this subcomponent. The distress type "Holes" may be valid for the subcomponent to which this subcomponent was attached. See "Holes" definition.
2) If the entire subcomponent is missing and needed, record "Missing" with a density of 100% at either *Medium* or *High* severity, as applicable.
3) Fasteners are not considered subcomponents. If any fasteners are missing, record the subcomponent being fastened as "Missing" at *Low* severity. Estimate density based on the number of similar fasteners needed.
4) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the missing subcomponent a leak has occurred, record the severity level as *High* and the distress type "Leaks," as well.

Severity Levels:

Low - Fasteners are missing.

Medium - Portion of or entire subcomponent absent, but not raised to the level of *High.*

High - Any of the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate.

Density: $\frac{A}{B}$ $x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Holes where fasteners are currently required
- Ceiling tiles removed and never replaced
- Exhaust fan removed, but still needed
- Missing pin in a hinge
- Missing pop rivet from sheet metal panel
- Handrail removed and never replaced
- Ladder rung was loose and fell out

Moisture/Debris/Mold Contaminated

Definition: The unintended presence of foreign material, vegetation, mold, mildew, water and/or other liquid.

Notes:
1) The presence of moisture, debris, sand, etc. does not necessarily constitute "Moisture/Debris/Mold Contaminated." The presence must exceed the amount normally expected through typical usage. Cleaning efforts would need to exceed those normally expected from routine housekeeping.
2) "Moisture/Debris/Mold Contaminated" is a special case of either "Damaged" or "Deteriorated." When present, use "Moisture/Debris/Mold Contaminated" instead of either "Damaged" or "Deteriorated."
3) After debris, mold, mildew, etc. removal or cleaning, record "Stained/Dirty" instead of "Moisture/Debris/Mold Contaminated," if staining remains.
4) If the foreign material is dirt, record "Stained/Dirty" instead of "Moisture/Debris/Mold Contaminated."
5) The distress type "Clogged" should be used in addition to "Moisture/Debris/Mold Contaminated" if the presence of leaves, etc. in drains, gutters, downspouts, troughs, screens, etc. is affecting water or air flow.
6) If the unit-of-measure of the subcomponent is "Each," estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes #10).
7) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and moisture/debris contamination has occurred to subcomponents where the logical repair would be the replacement of a unit (e.g. room carpeting) the measurement quantity will be that entire unit even though the actual contamination may only encompass portion of that unit. If the subcomponent can be patched, the measurement quantity will only encompass the area to be potentially patched.
8) Assign only one severity level to a given logical repair or replacement area, length, or quantity measured as described in 6) above.

Severity Levels:

Low - Distress exists.

Medium - Subcomponent is wet or contaminated, but not raised to the level of *High.*

High - Any of the following exists:
- Health, life/safety, security, or structural integrity problems.
- Cannot be cleaned, dried, or made useable.
- Other subcomponents may be damaged.

Measurement: Affected Area, Length, or Quantity, as appropriate.

Density: $\frac{A}{B}$ $x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Gutters filled with leaves
- Trash on roof
- The presence of leaves in air handling unit coils
- Leaves present on insect screen to air intake vent
- Wet insulation
- Flood or water damage
- Bird, animal, or insect nest
- Grass growing in cracks in sidewalk
- Moss growing on side of building
- Unintended vines growing up downspout
- Mold or mildew growing on wall

Noise/Vibration Excessive

Definition: Equipment noise and/or vibration in excess of normal or acceptable levels.

Severity Levels:

Medium - Noise or vibration can be corrected through adjustment.

High - Noise or vibration can only be corrected through replacement of one or more parts.

Measurement: Each

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Quantity
B = Total Quantity of Subcomponent

Distress Examples:

- Wobbly or squeaky ceiling fan
- HVAC compressor motor with unusual whine
- Transformer with noisy “hum.”

Operationally Impaired

Definition: Subcomponent does not operate properly or at all due to improper installation or construction, misalignment, binding, over tightening, malfunctioning, part failure, or repair/maintenance practices.

Notes:
1) "Operationally Impaired" only applies to subcomponents of components normally associated with "operating." These include, but are not limited to, equipment, doors, windows, light fixtures, etc.
2) If impairment is caused by "Damage," "Corroded," "Animal/Insect Damage," "Rotted," or other distress types, record those distress types at the appropriate severity levels in addition to "Operationally Impaired." "Operationally Impaired" shall not be used with the distress type "Broken." "Operationally Impaired" is recorded used instead of "Broken" if operability is lost, but there is no true separation of pieces or if a separation is unknown.
3) Often, it may appear that the component-section as a whole (e.g. air handling unit) or a component-section unit (e.g. one door out of two) is operationally impaired. Care must be taken to assign "Operationally Impaired" to the appropriate subcomponent(s).
4) If the component-section is a unit that would normally be replaced if it did not operate properly (e.g. residential hot water heater, sump pump, etc.), record "Operationally Impaired" for all of the subcomponents at the appropriate severity level.

Severity Levels:

Low - Subcomponent does not operate ideally.

Medium - Impairment is significant, but not raised to the level of *High*.

High - Either of the following exists:
- Health, life/safety or security problem.
- No operation of the component-section or a component-section unit

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Door difficult to close due to high humidity or improperly hung
- Door rattles in breeze
- Window cannot be opened due to over painting
- Window will not stay open
- Bumper installed in incorrect location
- Failed AC compressor
- Improper bend (too sharp) in lightning down conductor
- Sump pump does not work
- No hot water from hot water heater
- Exhaust fan blowing air in wrong direction

Overheated

Definition: Temperature exceeds normal or acceptable levels.

Notes:
1) If excessive heat has resulted in fire or other damage, the distress type, "Damaged" shall also be recorded at the applicable severity level.
2) If excessive heat has resulted in discoloration, the distress type "Stained/Dirty" shall also be recorded.
3) If evidence exists of overheating, but the subcomponent is not overheated at the time of the condition survey, ensure the problem that caused the overheating has been corrected. If uncertain, record "Overheated" at the appropriate severity level.
4) If evidence (e.g. damage or stains) exists of past overheating, but the overheating no longer exists, do not record "Overheated."

Severity Levels:

Medium - Excessively warm, but otherwise poses no health, life/safety, or operating problem.

High - Excessively warm or hot and poses a health, life/safety, or operating problem.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:
- Excessively warm electrical circuit breaker
- Evidence of heat damage around heater
- Discolored flue

Patched

Definition: An obvious localized repair to the subcomponent.

Notes:
1) "Patched" at *Medium* and *High* severities is a special case of deterioration. When present, record "Patched" instead of "Deteriorated."
2) The patch must be obvious. Patches that exist, but are virtually invisible will not be recorded.
3) Patched areas may also experience other distresses unrelated to the performance of the patch itself. Record "Animal/Insect Damaged," "Cracked," "Damaged," or "Stained," as applicable and if present, as well.
4) If a temporary patch has been placed to rectify any other distress type, record that distress type at one severity level lower than it would be without the temporary patch. Record in addition to "Patched."
5) If a patch is recorded as *High* severity, also record the underlying distress type and severity level for the subcomponent.

Severity Levels:

Low - Permanent patch exists and there is no deterioration.

Medium - Any of the following exists:
- Permanent patch is deteriorated.
- A material mismatch was used to make the patch.
- A temporary patch exists.

High - Patch has failed.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:
- Plaster repair of wall with poor workmanship
- Mastic to repair roof leak
- Pipe collar intended to repair pipe crack or hole
- Substitute prefabricated wall panel
- Color mismatch to replacement parts (when subcomponents are in plain sight)
- Isolated ceiling tile replacement of a different material
- Plywood covering over door or window
- Spackled area or holes in wall, but not painted over

Rotten

Definition: Fungal or bacterial decay or decomposition resulting in softness, sponginess, disintegration, loss of strength, and/or distortion of the subcomponent.

Notes:
1) "Rotten" is a special case of deterioration. When present, record "Rotten" instead of "Deteriorated."
2) Subcomponent may or may not be accompanied by a musty odor depending on the moisture state at the time of the condition survey.
3) If the unit-of-measure of the subcomponent is "Each," estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes #10).
4) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and rotting has occurred to subcomponents where the logical repair would be the replacement of a unit (e.g. window sill, wood cladding, etc.) the measurement quantity will be that entire unit even though the actual rotting may only encompass a portion of that unit. If the subcomponent can be patched, the measurement quantity will only encompass the area to be potentially patched.
5) Assign only one severity level to a given logical repair or replacement area, length, or quantity measured as described in 4) above.
6) If the subcomponent is a tank, pipe, container, trough, pressure vessel, or sealant and as a result of the rot a leak has occurred, record the severity level as *High* and the distress type "Leaks," as well.

Severity Levels:

Medium - Distress exists.

High - Any of the following exists:

- Health, life/safety, security, or structural integrity problems.
- Other subcomponents, component-sections, equipment, furnishings, material, or other building contents may be damaged from the entry of rain, snow, wind, groundwater, etc.
- A leak has resulted in a tank, pipe, container, trough, pressure vessel, or sealant.
- The undesired passage of animals, birds, or insects is occurring.
- The operation of another subcomponent, the parent component-section, or another component-section is adversely affected.
- The subcomponent is unusable.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Spongy roof deck
- Decayed soffit and fascia
- Wood column end loss of due to water emersion

Stained/Dirty

Definition: Subcomponent discoloration resulting from liquids, graffiti, smudges, mildew, mold, moss, algae, soot, dirt, animal waste, or other sources.

Notes:
1) "Stained/Dirty" will not be recorded if normal housekeeping will rectify the problem. Normal housekeeping includes regular or routine vacuuming, dusting, mopping, wiping, etc.
2) "Stained/Dirty" will be recorded if "special" cleaning is needed, including filter cleaning or replacement.
3) If discoloration is due to excessive heat, record "Stained/Dirty" and also record "Overheated," if applicable.
4) If discoloration is due to efflorescence, the record the distress type "Efflorescence" instead of "Stained/Dirty."
5) If mildew, mold, moss, or algae exist, record "Moisture/Debris/Mold Contaminated" instead of "Stained/Dirty." Only record "Stained/Dirty" if these contaminates have been removed, but a stain remains.
6) If the foreign material is other than dirt (e.g. leaves, vegetation, etc., record "Moisture/Debris/Mold Contaminated" instead of "Stained/Dirty."
7) The distress type "Clogged" should be used in addition to "Stained/Dirty" if the presence of dirt in screens, filters, coils, etc. is affecting air flow.
8) If discoloration is due to corrosion, the actual corroded area will be recorded as "Corroded" at the appropriate severity level, but the remaining area will be recorded as "Stained/Dirty."
9) Stains caused by animals, birds, or insects will be recorded as "Stained/Dirty" and not "Animal/Insect Damage."
10) If color mismatch exists due to a subcomponent part replacement, record "Patched" instead of "Stained/Dirty."
11) If surface is stained or dirty and painted (with paint inventoried as such), do not record "Stained/Dirty" for the section itself, but rate the paint according the definitions in Appendix F.
12) If the unit-of-measure of the subcomponent is "Each," estimate the density if the subcomponent is repairable or 100% if it must be replaced. (See General Notes #10).
13) If the subcomponent unit-of-measure is square feet (square meters) or linear feet (meters) and staining has occurred to subcomponents where the logical repair is the replacement of a unit (e.g. a ceiling tile), the measurement area will be that entire unit even though the actual stain may only encompass a portion of that unit.

Severity Levels:

Low - Distress exists.

Measurement: Affected Area, Length, or Quantity, as appropriate

Density: $\frac{A}{B}$ $x\ 100$ = Problem Density

Where: A = Affected Area, Length, or Quantity
B = Total Area, Length, or Quantity of Subcomponent

Distress Examples:

- Graffiti spray painted on wall
- Bird droppings
- Rust streaks
- Smudges on wall
- Localized ceiling tile discoloration due to past roof leak
- Widespread ceiling tile discoloration due to smoke, fumes, etc.
- Greasy/oily film on walls in a garage
- Excessively dirty floors in building that has been vacant for years
- Dirty filter reducing air flow
- Dirty cooling coils reducing air flow in an air handling unit

APPENDIX B – BUILT-UP ROOFING DISTRESS SURVEY DEFINITIONS

General Notes

1) These definitions are applicable to built-up (BUR) roofing surfaces and flashing components.

2) Where multiple severity levels are present for a given distress record each separately.

3) Distress quantities or distress density may be recorded. If distress quantities are recorded, density ranges will be computed in BUILDER/BRED. If distress densities are recorded, distress quantities will be blank in BUILDER/BRED.

4) If during the course of the inspection additional occurrences are found of distress-severity combinations, adjust the quantity or density as necessary.

5) To estimate density when distress quantities are not recorded, follow the density definitions for the individual distresses. However, for use in BUILDER, density may be estimated since density ranges are used, not the precise density value. Generalized visual cues are offered below in Table B1, but may not be applicable for certain distresses.

Table B1. Distress Density Estimation Visual Cues

Density (%)	Visual Cue (when applicable)
>0-0.1%	Difficult to notice even by careful observation, especially if spotty. (up to about 1"x 12" in a 8'x 10' area; ⅛" in 10' length)
>0.1-1%	Somewhat noticeable, but easily missed by casual observation, especially if spotty; Careful observation usually needed, if spotty. (up to about 10"x 12" in a 8'x 10' area; 1¼" in 10' length)
>1-5%	Noticeable, even by casual observation, but still only a mere fraction. (up to about 1'x 4' in a 8'x 10' area; 6" in 10' length)
>5-10%	Easily noticeable even if spotty; more than a mere fraction. (up to about 1'x 8' in a 8'x 10' area; 1' in 10' length)
>10-25%	Readily noticeable, but less than ¼ of area or length.
>25-50%	Very noticeable, but less than ½ of area or length.
>50-<100%	Overwhelmingly noticeable; greater than ½ of area or length.
100%	Entire area or length.

6) These distress definitions are reproduced from <u>Membrane and Flashing Condition Indexes for BuiltUp Roofs, Volume II: Inspection and Distress Manual</u>, USACERL Technical Report M-87/13 by Shahin, Bailey, and Brotherson.

Distress Summary Listing

1. (BUR) Base Flashing
2. (BUR) Metal cap Flashing
3. (BUR) Embedded Edge Metal
4. (BUR) Flashed Penetrations
5. (BUR) Pitch Pans
6. (BUR) Interior Drains and Roof Level Scuppers
7. (BUR) Blisters
8. (BUR) Ridges
9. (BUR) Splits
10. (BUR) Holes
11. (BUR) Surface Deterioration
12. (BUR) Slippage
13. (BUR) Patching
14. (BUR) Debris and Vegetation
15. (BUR) Improper Equipment Supports
16. (BUR) Ponding

(BUR) Base Flashing

***Definition*:** Base flashing is one or more piles of material extend from the roof surface up onto vertical or inclined surface providing a watertight termination of the membrane.

***Severity Levels*:**

Low - Any of the following conditions:

1. Loss of surfacing on mineral-surfaced sheets or other poor appearance (including patching) but no apparent deterioration of felts.
2. Top of base flashing is less than 6 in. above the roof surface.
3. Flashing has permanent repairs.

Medium - Any of the following conditions:

1. Slippage, wrinkling, blistering, or pulling of base flashing material.
2. Loss of surfacing with some deterioration of felts but no holes, splits, or tears.
3. Grease, solvent, or oil drippings on the base flashing but no deterioration of felts.
4. Flashing has temporary repairs.

High - Any of the following conditions:

1. Holes, split tears in flashing caused by deterioration or physical damage.
2. Exposed gaps at the top of the base flashing which are not covered by counter-flashing or open side laps in the flashing which allow water to channel behind them.
3. Grease, solvent, or oil drippings on the base flashing with deterioration of the felts.

Measurement: Measure lineal feet of base flashing having the above conditions. Holes, open side laps, and seams count as 1 ft each. If an area of the base flashing is at medium severity and holes are closer than 6 in., count that entire length of distressed base flashing as high severity.

Density: $\frac{A}{B} \times 100$ = Problem Density

Where: A = length of base flashing defects (ft)
B = total length of flashed perimeter of roof section being rated including flashings for penthouses, courtyards, and curbed projections)

(BUR) Metal Cap Flashing

Definition: Metal cap flashing includes counterflashing and any sheet metal coping cap which serves as part of the counterflashing or the cover over a detail such as a roof area divider, equipment curb, raised roof edge, or an expansion joint (including the rubber bellows of an expansion joint).

Note: Counterflashing is the material, usually sheet metal, which protects the top termination of base flashing and sheds water away from it. Counterflashing should be free to expand and contract.

Severity Levels:

Low - Any of the following conditions:

1. Loss of paint or protective coating or start of metal corrosion.
2. Metal coping cap is deformed and allows water to pond on the top.
3. Counterflashing is deformed but still performing its function.
4. Counterflashing has been sealed to the base flashing.

Medium - Any of the following conditions:

1. Corrosion holes have occurred through the metal on a vertical Surface.
2. Metal coping cap has loose fasteners, failure of soldered or sealed joints, open joints, or loss of attachment.
3. Sealant at reglet or top of counterflashing is missing or no longer functioning, allowing water to channel behind counterflashing.
4. Counterflashing is loose at the top, allowing water to channel behind it.
5. Counterflashing does not extend over top of base flashing.

High **-** Any of the following conditions:

1. Metal coping cap or counterflashing is missing or displaced from its original position.
2. Corrosion holes have occurred through the metal on a horizontal surface.
3. Metal coping cap has mission joint covers where joint covers were originally installed.

Measurement: Measure lineal feet of metal cap flashing having the above conditions. For individual defects (i.e., joints, holes) count as one foot minimum.

Density:

$$\frac{A}{B} \text{ x } 100 = \text{Problem Density}$$

Where: A = length of metal cap flashing defects (ft)
B = total length of flashed perimeter of roof section being rated (including flashings for penthouses, courtyards, and curbed projections)

(BUR) Embedded Edge Metal

Definition: Formed strip of metal at the roof edge which continues down the vertical part of the wall to form a fascia or drip. This stripped-in flashing provides a finished termination for the roofing membrane. A formed vertical projection (gravel stop) may be incorporated to prevent loose aggregate from rolling or washing off the roof. Exterior and interior gutter in a built-in trough of metal or other material which collects water from the roof and carries it to a downspout.

Note: A raised roof edge which is not stripped in, is rated as metal cap flashing and not embedded edge metal.

Severity Levels:

Low - The entire length of embedded edge metal flashings is rated low severity as a minimum due to the maintenance problems associated with it.

Medium - Any of the following conditions:

1. The joints in embedded edge metal flashings are rated medium severity as minimum due to the maintenance problems associated with them.
2. Nails under the stripping felts are backing out.
3. Corrosion of the metal.
4. Loose or lifted metal flange without deterioration of the stripping felts.
5. The entire length of interior gutter is rated medium severity as a minimum due to the maintenance problems and high potential for leak damage associated with its presence.

High - Any of the following conditions:

1. Stripping felts are missing or loose.
2. Splits in the stripping felts above the metal joints.
3. Holes have occurred through the metal.
4. Loose or lifted metal flange with deterioration of the stripping felts.
5. Holes or joint movement is present in the interior gutter.

Measurement: Measure lineal feet of embedded edge metal flashing having the above conditions. Each split above a joint is counted as one foot. As a method of sampling the joints, determine to total number of joints by dividing the total length of embedded edge metal flashing by the length of edge metal sections (normally 10 ft). Every fourth joint should be inspected for splits in the stripping felts. Count the number of inspected joints that are high severity and multiply by 4 to determine the total lineal feet of high severity joints. All other joints are rated medium severity. Multiply the number of inspected joints not rated high severity by 4 to determine the total lineal feet of medium severity joints.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = length of embedded edge metal flashing defects (ft)
B= total length of flashed perimeter of roof section being rated (including flashings for penthouses, courtyards and curbed projections)

(BUR) Flashed Penetrations

Definition: Open pipes, plumbing vent stacks, flues, ducts, continuous pipes, guy wires, drain sumps, and other penetrations through the roof membrane (excluding pitch pans but including metal curbing for hatches and ventilators, where the flange is stripped into the membrane).

Severity Levels:

Low - Either of the following conditions:
1. Flashing sleeve is deformed.
2. Opening in the penetration or flashing is less than 6 in. above the roof surface.

Medium - Any of the following conditions:
1. Edge of stripping felts is exposed but there is no apparent felt deterioration.
2. Top of flashing sleeve is not sealed or has not been rolled down into an existing plumbing vent stack.
3. The sleeve or umbrella is open or no umbrella is present (where required).
4. Metal is corroded.

High - Any of the following conditions:
1. Flashing sleeve or metal curb has been installed with no stripping felts
2. Flashing sleeve or metal curb is cracked, broken, or corroded through.
3. No flashing sleeve is present.
4. Penetration is not sealed at the membrane level.

Measurement: Count each distressed flashed penetration as one linear ft at the highest severity level which exists. For metal curbs and ducts with greater than 1 ft of perimeter, count the actual length (in feet) of distressed perimeter.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = lineal feet of distresed flashed penetrations
B = total length of flashed perimeter of roof section being rated (including flashings for penthouses, courtyards and curbed projections)

(BUR) Pitch Pans

Definition: A pitch pan is a flanged metal sleeve placed around a roof-penetrating element and filled with a sealer.

Severity Levels

Low - Pitch pans are rated low severity as a minimum due to the maintenance problems associated with them.

High - Any of the following conditions:
1. Metal corrosion.
2. Sealing material is below metal rim.
3. Stripping felts are exposed or deteriorated.
4. Sealing material has cracked or separated from pan or penetration.

Measurement: Each distressed pitch pan should be counted once at the highest severity level which exists.

Density:

$$\frac{A}{B} \text{ x } 100 = \text{Problem Density}$$

Where: A = number of distressed pitch pans
B = total length of flashed perimeter of roof section being rated (including flashings for penthouses, courtyards, and curbed projections)

(BUR) Interior Drains And Roof Level Scuppers

Definition: A drain is a penetration at the roof membrane which allows water to flow from the roof suface into a piped drainage system. The drain fixture at the roof has a flange and/or clamping arrangement to which the roofing membrane is attached. A roof level scupper is a cchannel through a parapet or raised roof edge which is designed for peripheral drainage of the roof.

Note: Stripping felts around scuppers should be carefully inspected for holes at corners.

Severity Levels:

Low - Bitumen has flowed into the drain leader but the drain is not clogged.

Medium - Any of the following conditions:

1. Stripping felts are exposed but there is no apparent deterioration of felts.
2. Strainer is broken or missing.
3. Scupper shows loss of paint or protective coating or start of metal corrosion.

High - Any of the following conditions:

1. Stripping felts have holes or are deteriorated.
2. Clamping ring is loose or missing from drain body or bolts are missing.
3. Drain is clogged.
4. Scupper metal is broken or holes have occurred through the metal.

Measurement: Each distressed drain and scupper should be counted once at the highest severity level which exists.

Density:

$$\frac{A}{B} \text{ x } 100 = \text{Problem Density}$$

Where: A = number of distressed interior drains and roof level scuppers
B = total length offlashed perimeter of roof section being rated (including flashings for penthouses, courtyards and curbed projections)

(BUR) Blisters

Definition: Blisters are round or elongated raised areas of the membrane which are filled with air.

Note: Blisters and ridges are difficult to differentiate at the low and medium severity levels. The rating error will be insignificant because of the similarity in the deduct curves. At high severity, however, it is important to distinguish between the two distresses due to their different leak potentials.

Severity Levels:

Low - The raised areas are noticeable by vision or feel. The surfacing is still in place and the felts are not exposed

Medium - The felts are exposed or show deterioration.

High - The blisters are broken.

Measurement: Measure the length and width of the blister in lineal feet and calculate the area (length times width). If the distance between individual blisters is less than 5 ft., measure the entire affected area in sq ft.

Note: When large quantities of this problem are present (especially on large roofs,), the representative sampling technique can be used.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of membrane blisters (sq ft)
B = total area of roof section being rated (sq ft)

(BUR) Ridges

Definition: Ridges are long, narrow (usually less than 3 in.), raised portions of the roof membrane. Their maximum height is about 2 in. Usually ridges occur directly above the insulation board joints and run perpendicular or parallel to the felts. They include all the plies and therefore are generally stiffer than blisters.

Note: Blisters and ridges are difficult to differentiate at the low and medium severity. The rating error will be insignificant because of the similarity in the deduct curves. However at the high severity, it is important to distinguish between the two distresses due to their different leak potentials.

Severity Levels:

Low - The ridges are noticeable but the felts are not exposed.

Medium - The ridges are raised and clearly visible. The surfacing on the ridge is gone and the top felt is exposed.

High - Either of the following conditions:

1. Open breaks have developed in the ridge.
2. Felt deterioration has progressed through the top ply. exposing underlying plies.

Measurement: Measure lineal feet of ridges running in all directions.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total length of membrane ridges (ft)
B = total area of roof section being rated (sq ft)

(BUR) Splits

Definition: Splits are tears that extend through all membrane felts. They vary in length from a few feet to the length of the roof and in width from a hair-line crack to more than 1 in. Splits generally occur directly above the joints between the long sides of insulation boards and run in the direction the felts were installed.

Severity Levels:

High - An unrepaired split or a repaired split which has started to re-open.

Measurement: Measure lineal feet of split.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total length of membrane splits (ft)
B = total area of roof section being rated (sq ft)

(BUR) Holes

Description: A membrane hole is any visible opening which extends through all membrane layers. Holes can be of various sizes and shapes, and can be located anywhere on the roof surface.

Severity Levels:

High - All holes in the membrane are considered high severity due to their high leak potential.

Measurement: Count the total number of holes in the membrane, If the distance between two holes is less than 1 ft., count them as one hole.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = number of membrane holes
B = total area of roof section being rated (sq ft)

(BUR) Surface Deterioration

Description: A built-up roofing membrane will generlly have one of the following types of surfacing: Aggregate surface, mineral surface-cap or smooth surface-coated. The membrane surface may show any of the following distressed condition:

1. Lack of top surface or coating.
2. Alligatoring (interconnected hairline cracks that resemble alligator hide).
3. Lack of adhesion between the membrane plies.

Note: Walkways are treated as part of the membrane surfacing.

Severity Levels:

Low - Any of the following conditions:

1. On aggegate surfaced roofs, the aggregate is not embedded or is poorly embedded but the felts remain covered with aggregate.
2. Open edge laps or fishmouths.
3. On smooth surfaced roofs, there is evidence of crazing of top surface with hairline cracks(alligatoring).
4. Walkways shows loss of surfacing, loss of adhesion, cracks, blistering or cracked coating.

Medium - Any of the following conditions:

1. On aggregate surfaced roofs, the aggregate is displaced and the top coat of bitumen is exposed.
2. On mineral surfaced-cap sheet roofs, the mineral granules have come off the cap sheet, exposing the underlying felt.
3. On smooth surfaced roofs, no surface coating exists or there is a loss of surface coating.
4. On smooth surfaced roofs, alligator cracks extend down through the bitumen to the top felt.

High - Any of the following conditions:

1. On aggregate surfaced roofs, the aggregate cover has been displaced and the bitumen pour coat is deteriorated, leaving the underlying felts exposed. The felts may be deteriorated.
2. On mineral surfaced-cap sheet roofs, the cap sheet felt is deteriorated.
3. On smooth surfaced roofs, alligator cracks extend down through one or more plies.
4. Shrinking of the walkway has torn the membrane below it.

Measurement: Measure square feet of each affected area and rate at highest severity level which exists.

Note: When large quantities of this problem are present (especially on large roofs), the representative sampling technique can be used.

Density: $\frac{A}{B} \times 100 =$ Problem Density

Where: A = total area of surface deterioration (sq ft)
B = total area of roof section being rated (sq ft)

(BUR) Slippage

Description: Slippage is a downslope lateral movement of felt plies. Slippage usually occurs on roofs with slopes greater than ¼ in./ft.

Severity Levels:

Low - Less than 2 in. of slippage has occurred, evidenced by the presence of narrow bare strips perpendicular to the slope.

Note: Low severity slippage requires inspection at 6 month intervals.

High - More than 2 in. of slippage has occurred. There is evidence of humping and wrinkling.

Measurement: Measure square feet of affected roof area. The affected area extends from the high point on the slope where bare felts are noticeable, down to the low point of the slope or the area where humping and wrinkling are noticeable.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total affected area of roof (sq ft)
B = total area of roof section being rated (sq ft)

(BUR) Patching

Description: Patching is a localized temporary or permanent repair of the membrane using dissimilar materials. Repairs made with similar materials are not counted as patches; distresses associated with these repairs should be recorded in the appropriate category and not as patching distresses.

Severity Levels:

Low - All patches that are not made with similar materials as that of the original construction are rated as low severity as a minumum.

Medium - All patches made with temporary materials (i.e., duct tape, caulkings, and sealants) are rated medium severity as a minimum.

High - Other distresses of high severity are present within the patched area (count as patching distress only).

Measurement:

1. Measure square feet of each patch having the above conditions.
2. When large quantities of this problem are present, the representative sampling technique may be used.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of patching (sq ft)
B = total area of roof section being rated (sq ft)

(BUR) Debris and Vegetation

Definition: Foreign objects on the roof which could damage or puncture the membrane, the growth of vegetation on the roof, and/or the accumulation of solvent and oil drippings on the roof.

Severity Levels:

Medium - Any of the following conditions:

1. The collection of foreign objects which are not removed from the roof during the inspection.
2. Grease, solvent, or oil drippings on the roof which is causing degradation of the roof membrane.
3. Evidence of vegetation, but not penetrating the felts.

High - Any of the following conditions:

1. Grease, solvent, or oil drippings on the roof which is causing degradation to the roofing system.
2. Vegetation roots that have penetrated the felts.

Measurement: Measure square feet of affected area. Each isolated case of debris and vegetation of less than 1 sq ft in area should be counted as 1 sq ft.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of debris and vegetation (sq ft)
B = total area of roof section being rated (sq ft)

(BUR) Improper Equipment Supports

Definition: Improper equipment supports or pipes, conduits, and mechanical equipment supports (wood sleepers, channels, etc) that are placed directly on the membrane below the equipment. Repairing this distress may require replacing the surrounding insulation and membrane.

Severity Levels:

Low - All improper equipment supports are rated low severity as a minimum due to the maintenance problems associated with them.

Medium - Any of the following defects:
1. Movement of the support has displaced the membrane, but has not cut or punctured it.
2. Equipment is bolted through the membrane but the membrane is sealed and watertight.

High - Any of the following defects:
1. Movement of the support has cut or punctured the roof membrane.
2. The equipment is bolted through the membrane and the membrane is not sealed, allowing water to penetrate.

Measurement: Measure square feet of each improper equipment support. The minumum dimensions for the length and width of a support shall be 1 ft.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of improper equipment supports (sq ft)
B = total area of roof section being rated (sq ft)

(BUR) Ponding

Definition: Standing water is present or there is evidence of ponding by the presence of staining. Water which remains after 48 hr. is considered ponded water.

Severity Levels:

Low - Ponding is rated low severity due to the maintenance problems associated with it.

Measurement: Measure square feet of affected area.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of ponding (sq ft)
B = total area of roof section being rated (sq ft)

APPENDIX C – SINGLE PLY ROOFING DISTRESS SURVEY DEFINITIONS

General Notes

1) These definitions are applicable to Single Ply roofing surfaces and flashing components.

2) Where multiple severity levels are present for a given distress record each separately.

3) Distress quantities or distress density may be recorded. If distress quantities are recorded, density ranges will be computed in BUILDER/BRED. If distress densities are recorded, distress quantities will be blank in BUILDER/BRED.

4) If during the course of the inspection additional occurrences are found of distress-severity combinations, adjust the quantity or density as necessary.

5) To estimate density when distress quantities are not recorded, follow the density definitions for the individual distresses. However, for use in BUILDER, density may be estimated since density ranges are used, not the precise density value. Generalized visual cues are offered below in Table C1, but may not be applicable for certain distresses.

Table C1. Distress Density Estimation Visual Cues

Density (%)	Visual Cue (when applicable)
>0-0.1%	Difficult to notice even by careful observation, especially if spotty. (up to about 1"x 12" in a 8'x 10' area; ⅛" in 10' length)
>0.1-1%	Somewhat noticeable, but easily missed by casual observation, especially if spotty; Careful observation usually needed, if spotty. (up to about 10"x 12" in a 8'x 10' area; 1¼" in 10' length)
>1-5%	Noticeable, even by casual observation, but still only a mere fraction. (up to about 1'x 4' in a 8'x 10' area; 6" in 10' length)
>5-10%	Easily noticeable even if spotty; more than a mere fraction. (up to about 1'x 8' in a 8'x 10' area; 1' in 10' length)
>10-25%	Readily noticeable, but less than ¼ of area or length.
>25-50%	Very noticeable, but less than ½ of area or length.
>50-<100%	Overwhelmingly noticeable; greater than ½ of area or length.
100%	Entire area or length.

6) These distress definitions are reproduced from Membrane and Flashing Condition Indexes for Single-Ply Membrane Roofs-Inspection and Distress Manual, USACERL Technical Report FM-93/11 by Bailey, Brotherson, Tobiasson, Foltz, and Knehans.

Distress Summary Listing

1. (SP) Base Flashing-Membrane Material
2. (SP) Base Flashing-Coated Metal
3. (SP) Metal cap Flashing
4. (SP) Embedded Edge Metal
5. (SP) Flashed Penetrations
6. (SP) Pitch Pans
7. (SP) Interior Drains and Roof Level Scuppers
8. (SP) Splits
9. (SP) Ridges
10. (SP) Holes, Cuts, and Abrasions
11. (SP) Defective Seams
12. (SP) Surface Coating Deterioration
13. (SP) Membrane Deterioration
14. (SP) System Securement Deficiencies
15. (SP) Membrane Support Deficiencies
16. (SP) Patching
17. (SP) Debris and Vegetation
18. (SP) Improper Equipment Supports
19. (SP) Ponding

(SP) Base Flashing-Membrane Material

***Definition**:* Base flashing is composed of membrane material or other flexible material. The base flashing extends from the roof surface upward above the plane of the membrane to provide a watertight termination of the membrane.

***Severity Levels**:*

Low - Any of the following defects:

1. Light crazing or eroding of the base flashing.
2. Top of the base flashing is less than 6 in. above the membrane
3. Nailing strip or flashing batten with exposed fasteners is less than 6 in above the roof surface.
4. Seam or side lap is open less than ½ in.
5. Flashing has repairs with compatible materials.

Medium - Any of the following defects:

1. Crazing or eroding of the base flashing that has worn through to a reinforcement or scrim sheet or down to another layer of different color, or has resulted in obvious loss of sheet thickness.
2. Slippage, wrinkling, blistering, pulling, unbonding, or bridging of base flashing material that does not allow water to penetrate.
3. The presence of solvents, oil, or other chemicals with deterioration of the base flashing but does not allow water to penetrate.
4. Flashing has repairs made with dissimilar materials.
5. Seam or side lap is open more than ½ in. but does not allow water to penetrate the flashing.
6. Loose or missing termination bar where no counterflashing is used.
7. Loose or missing nailing strip.

High - Any of the following defects:

1. Crazing or eroding of the base flashing that has worn through the flashing allowing water to penetrate.
2. Holes, splits, or tears in base flashing, allowing water to penetrate.
3. Exposed gaps at top of the base flashing.
4. Seam or side lap is open through its entire width, allowing water to penetrate the flashing.
5. Holes through the base flashing caused by solvent, oil, or ther chemicals.

Measurement: Measure length (ft) or base flashing having the above conditions. Holes, open side laps, and seams count as 1 ft each.

Density: $\frac{A}{B} \; x \; 100$ = Problem Density

Where: A = length of base flashing defects (ft)
B = total length of flashed perimeter of roof section being rated (including perimeter flashings and flashings for penthouses, courtyards, and curbed projections)

(SP) Base Flashing-Coated Metal

***Definition**:* Base flashing material is composed of membrane-coated metal. The metal extends from the roof surface upwards above the plane of the membrane providing a watertight termination of the membrane.

***Severity Levels**:*

Low - Any of the following defects:

1. Loss of protective coating or light corrosion.
2. Distortion of joint covers.
3. Top of flashing is less than 6 in. above the roof surface.
4. Exposed fasteners.

Medium - Any of the following defects:

1. Joint cover is unbonded to metal base flashing, but does not allow water to penetrate.
2. Coated metal base flashing fasteners are loose.
3. Coated metal base flashing has pulled away from the wall or curb or has lifted up but top termination is watertight.
4. Crazing or eroding of the joint cover material that has not worn through and does not allow water to penetrate.
5. Coated metal base flashing has repairs made with dissimilar materials.

High - Any of the following conditions:

1. Holes in metal base flashing.
2. Hole in joint cover or unbonding of joint cover from metal base flashing, allowing water to penetrate.
3. Exposed gaps at top termination of the base flashing.
4. Coated metal base flashing has pulled away from the wall or curb or has lifted up, allowing water to penetrate (rate full section of metal, normally a 10-ft length).

Measurement: Measure length (ft) of base flashing having the above conditions. Holes, open side laps, and seams count as 1 ft each. Each joint cover having a hole is counted as 1 ft. As a method of sampling the joint covers for ballasted systems, determine the total number of existing joints by dividing the total length of coated metal base flashing by the length of metal sections (usually 10 ft). Every fourth joint should be inspected for defects in the cover strip. Count the number of inspected joints having a specific defect and multiply by 4 to determine the total length of the defect.

Density: $\frac{A}{B} \times 100$ = Problem Density

Where: A = length of base flashing defects (ft)
B = total length of flashed perimeter of roof section being rated (including perimeter flashings and flashings for penthouses, courtyards, and curbed projections)

(SP) Metal Cap Flashing

***Definition*:** Metal cap flashing includes any sheet metal that serves to counterflash or cover a detail such as a parapet, firewall, roof area divider, equipment curb, raised roof edge, or an expansion joint, protecting the top termination of the base flashing and shedding water away from it. The metal cap flashing should be free to expand and contract.

Note: Note all single plys are installed with counterflashing to protect the top of the base flashing

***Severity Levels*:**

Low - Any of the following defects:

1. Loss of protective coating or corrosion without holes.
2. Top of counterflashing or metal coping is deformed and allows water to pond on the top.
3. Metal cap flashing is deformed but still performing its function.
4. Metal cap flashing has been sealed to base flashing

Medium - Any of the following defects:

1. Corrosion has caused holes in the metal on a sloping or vertical surface.
2. Metal cap flashing has loose fasteners, failure or soldered or sealed joints, or loss of attachment.
3. Metal cap flashing has rough edges that are in contact with the base flashing.

High - Any of the following conditions:

1. Metal cap flashing is missing or displaced from its original position.
2. Corrosion has caused holes in the metal on a horizontal surface.
3. Metal cap flashing has open joints or missing joint covers where covers were originally installed.
4. Sealant at reglet or top of counterflashing is missing or no longer functional, allowing water to channel behind it.
5. Counterflashing is loose at the top allowing water to channel behind it.
6. Metal cap flashing does not extend over top of the base flashing.

Measurement: Measure length (ft) or metal cap flashing having the above conditions. Individual defects (i.e., joints, holes) count as 1 ft minimum.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = length of metal cap flashing defects (ft)
B = total length of flashed perimeter of roof section being rated (including perimeter flashings and flashings for penthouses, courtyards, and curbed projections)

(SP) Embedded Edge Metal

Definition: Embedded edge metal is a formed strip of metal at the edge of the roof that continues down the vertical part of the wall to form a fascia or drip edge. This stripped-in flashing provides a finished termination for the roofing membrane. On all but coated-metal flashing systems, the metal is placed on top of the membrane, and fastened to the deck through it. To make the area watertight, the metal is covered with membrane or flashing material (i.e., it is stripped in). Coated metal systems have their edge metal placed before the membrane. The membrane is adhered to the top of the coated metal, thereby eliminating the need to have it stripped in. A formed vertical projection (gravel stop) may be incorporated to prevent ballast from rolling or wahing off the roof. Exterior and interior gutters, which are embedded in the membrane, are considered embedded edge metal. (an interior gutter is a built-in trough of metal or other material that collects water from the roof and carries it to a drain or downspout.)

Severity Levels:

Low - Any of the following defects:

1. Loss of protective coating or light corrosion.
2. Termination battens have exposed fasteners.
3. Stripping material is open less than ½ in.
4. Distortion of joint covers.
5. For coated metal edge flashings that are not stripped in, membrane is open less than ½ in.

Medium - Any of the following defects:

1. Joint cover is unbonded to embedded edge metal, but does not allow water to penetrate.
2. Nails under stripping material are backing out.
3. Stripping material is crazing, checked, or cracked.
4. Stripping material is open more than ½ in., but edge metal fasteners are not exposed.
5. Loose or lifted metal with deterioration of the stripping material.
6. Embrittled joint stripping material.
7. The entire length of interior gutter is rated medium as a minimum due to the potential for leak damage.
8. For coated metal edge flashing that are not stripped in, membrane is open more that ½ in. but does not allow water to penetrate.

High - Any of the following conditions:

1. The stripping material is missing or open and edge metal fasteners are exposed, or stripping material has holes, cuts or tears, allowing water to penetrate.
2. Hole in joint cover or unbonding of joint cover from embedded edge metal, allowing water to penetrate.
3. Holes through the metal.
4. Holes associated with loose or lifted embedded edge metal.
5. Holes in interior gutter.
6. For coated metal edge flashing that are not stripped in, membrane is open allowing water to penetrate.

Measurement: Each split above a joint is counted as 1 ft. As a method of sampling the embedded edge metal joints for ballasted systems, determine the number of joints by dividing the total length of embedded edge metal flashing by the length of the edge metal sections (often 10 ft). Gravel should be moved at every fourth joint and the stripping material inspected for splits. Count the number of inspected joints having a specific defect and multiply by four to determine the total length of the defect.

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = length of embedded edge metal flashing defects (ft)
B = total length of flashing on roof section being rated (including perimeter flashings and flashings for penthouses, courtyards, and curbed projections)

(SP) Flashed Penetrations

***Definition**:* This category includes pipes, plumbing vent stacks, flues, ducts, conduits, guy wires, drin sumps, and other penetrations through the roof membrane (excluding pitch pans but including metal curbing for hatches and ventilators, where the metal flange is stripped into the membrane or, in the case of some coated metal flashing systems, the membrane is adhered to the top of the coated metal flange, thereby eliminating the need to have it stripped in).

***Severity Levels**:*

Low - Any of the following defects:

1. Flashing sleeve is deformed.
2. Stripping material, boot, or membrane (for coated metal flashing sleeves) is open less than ½ in.
3. Top of flashing is less than 6 in. above the membrane.

Medium - Any of the following defects:

1. Stripping material is crazing, checked, or cracked.
2. Stripping material, boot, or membrane (for coated metal flashing sleeves) is open more than ½ in. but does not allow water to penetrate the flashing.
3. Top of flashing sleeve or boot is not sealed or is not rolled down into the existing plumbing vent stack.
4. Clamping band is loose or missing (where required).
5. Umbrella is open or no umbrella is present (where required).
6. Corrosion of metal or delamination of coating.

High - Any of the following conditions:

1. Stripping material has holes, cuts, or tears.
2. Stripping material, boot, or membrane (for coated metal flashing sleeves) is open, allowing water to penetrate.
3. Holes, cuts, or tears in flashing sleeve or metal curb.
4. No flashing sleeve present.
5. Incompatible flashing material has been used.

Measurement: Count each small distressed flashed penetration as 1 ft at the highest severity level present. For metal curbs and ducts with more than 1 ft of perimeter, measure the length (in ft) of the distressed perimeter.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = length of distressed flashed penetration (ft)
B = total length of flashed perimeter of roof section being rated (including perimeter flashings and flashings for penthouses, courtyards, and curbed projections)

(SP) Pitch Pans

Definition: A pitch pan is a flanged metal sleeve placed around a roof penetration element and filled with a sealer. For pitch pans on ethylene-propylene-diene monomer (EPDM) and Hypalon roofing systems, stripping materials should cover the sides of the metal pan and terminate within the pan below the sealer.

Severity Levels:

Low - All pitch pans are low severity at a minimum due to maintenance requirements.

Medium - Any of the following defects:

1. Stripping material is crazing, checked, or cracked.
2. Stripping material or membrane (on coated metal pitch pans) is open more than ½ in. but does not allow water to penetrate the flashing.
3. Loss of protective coating or corrosion of metal.
4. For EPDM and Hypalon, stripping material is not covering the top of the metal pan or does not terminate below the sealer.

High - Any of the following conditions:

1. Stripping material has holes, cuts, or tears, allowing water to penetrate through.
2. Edge of stripping material or membrane (on coated metal pitch pans) is open, allowing water to penetrate.
3. Sealer is below the metal rim, allowing ponding in the pan.
4. Sealer has cracked or separated from the pan or penetration.
5. Corrosion through the metal pan.

Measurement: Each distressed pitch pan should be counted once at the highest severity level present.

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = number of distressed pitch pans (ft)
B = total length of flashing on roof section being rated (including perimeter flashings and flashings for penthouses, courtyards, and curbed projections)

(SP) Interior Drains and Roof Level Scuppers

Definition: A drain is a penetration of the roof membrane that allows water to flow into a piped drainage system. The drain fixture at the roof has a flange and/or clamping arrangement to which the roofing membrane is attached. A scupper is a channel through a parapet or raised roof edge that is designed to drain the roof. Roof-level scuppers are for primary drainage. Elevated (overflow) scuppers are for emergency drainage.

Note: Most single-ply roofing systems do not require stripping material around the drain.

Severity Levels:

Low - Any of the following defects:

1. Field seam within 1 ft of a drain or roof-level scupper.
2. Stripping material or membrane is open less than ½ in.

Medium - Any of the following defects:

1. Crazing material is crazing, checked, or cracked.
2. Stripping material or membrane is open ½ in. or more, but does not allow water to penetrate.
3. Strainer is broken or missing
4. Scupper shows loss of protective coating or start of metal corrosion.
5. Drain has a field seam in the claming ring.

High - Any of the following conditions:

1. Stripping material has holes, cuts or tears, allowing water to penetrate.
2. Stripping material or membrane is open, allowing water to penetrate.
3. Clamping ring is loose or missing from drain or bolts are missing.
4. Drain is clogged.
5. Scupper is broken or contains holes.
6. Holes, cuts, tears, or abrasions through the membrane within 2 ft of the drain or scupper.

Measurement: Each distressed drain and scupper should be counted once at the highest severity level present.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = number of distressed interior drains and scuppers (ft)
B = total length of flashing on roof section being rated (including perimeter flashings and flashings for penthouses, courtyards, and curbed projections)

(SP) Splits

Definition: Splits are cracks or tears that extend through the membrane. They vary in length from a few inches to the length of the roof and in width from hair-line to more than 1 in.

Severity Levels:

High - All splits in the mebrane are considered high severity due to their leak potential.

Measurement: Measure length of split.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = total length of membrane splits (ft).
B = total area or roof section being rated (sq ft).

(SP) Ridges

Definition: Ridges are long, narrow (usually less than 3 in.), raised portions of the roof membrane. Usually ridges occur directly above the insulation board joints.

Severity Levels:

Low - All ridges are rated low severity as a minimum.

High - Open breaks have developed in the ridge allowing water to penetrate.

Measurement: Measure length of ridges running in all directions. When many ridges are present, the representative sampling technique may be used.

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = total length of membrane ridges (ft).
B = total area or roof section being rated (sq ft).

(SP) Holes, Cuts, and Abrasions

Definition: Holes and cuts are membrane distresses caused by physical abuse from tools, traffic, debris, gravel, wind, etc., or manufacturing defects such as pinholes. Holes and cuts can be of various shapes and sizes. Abrasion is physical damage that has roughened or worn the membrane surface.

Severity Levels:

Low - Surface scratches or abrasions with no significant loss of membrane thickness.

Medium - Cuts, gouges, or abrasions with loss of membrane thickness but not fully penetrating the membrane.

High - Any of the following defects:
1. Holes, cuts, gouges, or abrasions that penetrate the membrane.
2. Holes, through the membrane caused by underlying mechanical fasteners.

Measurement:

1. Count the total number of scratches, gouges, holes, and cuts in the membrane. If the distance between distresses is less than 1 ft, count the distresses as one. If the distress is longer than 1 ft, measure the length. Measure area of abrasion in square feet.
2. When large quantities of this problem are present, the representative sampling technique may be used.

Density: $\frac{A}{B} \times 100$ = Problem Density

Where: A = total number and/or length of membrane scratches, gouges, holes, and cuts (ft) or total area of abrasion (sq ft).
B = total area or roof section being rated (sq ft).

(SP) Defective Seams

Definition: Defective seams include imcomplete, damaged, or weak seams that join two sheets of a membrane.

Note: For EDPM and polyvinyl chloride (PVC) membranes, all field seams should have lap sealant at the edges. All other membranes should have lap sealant at cut edges of seams that have exposed reinforcement material.

Severity Levels:

Low - Any of the following defects:

1. Missing lap sealant at field seam (EPDM) and PVC membranes only).
2. Missing lap sealant at field seam, which has exposed reinforcement material at seam edge (usually at end laps and field-cut edges of sheets).
3. Seam is open less than ½ in.
4. Wrinkling at seam that is watertight.
5. Seam intersections (e.g., T-joints) on EPDM that do not have a patch covering them.
6. Blisters within the seam.

Medium - Any of the following defects:

1. Seam is open ½ in. or more, but does not allow water to penetrate the membrane.
2. Pinch wrinkle at seam.

High - Any of the following conditions:

1. Seam is open through is entire depth, allowing water to penetrate.
2. Fishmouths, wrinkles, or bunches at the seam that allow water to penetrate.

Measurement: For exposed membranes (no overlying ballast), inspect all seams visually.

For ballasted roofs, check field seams at five different locations on the roof section. Clear ballast from 5 ft of the seam at each location that clean the exposed seam with a whisk broom. If all checked seams are without defects, assume the remaining field seams are satisfactory. If any defects are found, use the following sampling technique.

1. For roof sections with sheet widths of 10 ft or less, inspect 2 percent of the total length of field seams (2 ft every 100 ft of seam). For roof sections having sheet widths greater than 10 ft, inspect 4 percent of the total length of field seams (2 ft every 50 ft of seam). Measure length of each specific seam defect found.

2. Extrapolate to determine the total length of seam defects for the entire roof section from the total length of defect found. When 2 percent of the seams are inspected, multiply the actual defect length by 50 to compute total length of defect. When 4 percent of the seams are inspected, multiply actual defect length by 25 to compute total length of defect.

Density: $\frac{A}{B}\ x\ 100$ = Problem Density

Where: A = total length of defective seams (ft)
B = total area of roof section being rated (sq ft).

(SP) Surface Coating Deterioration

***Definition**:* Surface coating deterioration includes wear, blistering, or peeling of any surface coating applied for fire protection (such as adhesive coating and sand on an EPDM membrane) or solar reflectivity, but not waterproofing.

***Severity Levels**:*

Low - Color of underlying membrane can be seen through the coating or membrane has lost protection (for membrane with coating protection that does not have sand or mineral matter embedded).

Medium - Membrane area has lost the sand or mineral matter portion of the coating protection (for membrane with coating protection that has sand or mineral matter embedded).

Measurement:

1. Measure the square feet of each affected area and rate at the highest severity level present.
2. When large quantities of this problem are present, the representative sampling technique may be used.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = total area of surface coating deterioration (ft)
B = total area of roof section being rated.

(SP) Membrane Deterioration

Definition: This category includes erosion or crazing or the membrane. Erosion is the wearing away of the membrane surface creating a rough texture. Crazing is hairline cracking of the membrane.

Severity Levels:

Low - Light crazing of the membrane surface.

Medium - Crazing or eroding of the membrane surface that has worn through to a reinforcement or scrim sheet or down to another layer of different color, or has resulted in obvious loss of sheet thickness.

High - Crazing or eroding of the membrane surface that has worn through the membrane allowing water to penetrate.

Measurement:

1. Measure the square feet of each affected area and rate at the highest severity level present.
2. When large quantities of this problem are present, the representative sampling technique may be used.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = total area of membrane deterioration (ft)
B = total area of roof section being rated.

(SP) System Securement Deficiencies

Definition: For fully adhered membranes, system securement deficiencies include membrane areas (including blisters) that are unattacted to the substrate. For mechanically attacted membranes, this category includes failed mechanical fasteners. For partially adhered membranes, the category includes membrane that is not adhered at points of attachment. For ballasted membranes, the membrane has areas where ballast is missing or displaced.

Note: Holes in the membrane caused by mechanical fasteners are rated as Holes.
Note: If ballast is redistributed by the inspector to cover bare areas, ther areas should not be counted as defects.
Note: For defect definitions, "building perimeter" is area within 10 ft of a roof edge. These reas experience high wind uplift pressures.

Severity Levels:

Low - Any of the following defects:

1. For fully adhered systems, an area of unattached membrane substrate of 2 sq ft or less.
2. For ballasted systems, a bare area of 4 sq ft or less.

Medium - Any of the following defects:

1. For fully adhered systems, an area of unattached membrane substrate of greater than 2 sq ft but less than 100 sq ft (less than 25 sq ft at building perimeter).
2. For mechanically attached systems, an isolated mechanical fastener that has lost its attachment capability or backed out causing bridging of the membrane.
3. For partially adhered systems, an isolated point of attachment that has lost adherence.
4. For ballasted systems, a bare area of greater than 4 but less than 100 sq ft (less than 25 sq ft at building perimeter).

High - Any of the following conditions:

1. For fully adhered systems, an area of unattached membrane or substrate 100 sq ft of greater (25 sq ft at building perimeter).
2. For mechanically attached systems, adjacent mechanical fasteners that have lost their attachment capability or backed out causing bridging of the membrane.
3. For partially adhered systems, adjacent points of attachment that have lost adherence.
4. For ballasted systems, a bare area of 100 sq ft or greater (25 sq ft at building perimeter).

Measurement:

1. Measure square feet of membrane having the above conditions. For mechanically fastened and partially adhered systems, count the effective area of unattached membrane.
2. When large quantities of this problem are present, the representative sampling technique may be used.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = total area of attachment defects (ft)
B = total area of roof section being rated (sq ft).

(SP) Membrane Support Deficiencies

Definition: The surface on which the membrane rests may not be smooth and continuous. For fully adhered membranes, partially adhered membranes, partially adhered membranes, and mechanically attached membranes, this category includes warping, bowing, or shrinking of insulation boards. For ballasted membranes, it includes displaced insulation boards. Localized absence of membrane support may be due to missing components below.

Note: Mechanical fasteners and loose insulation boards are rated as System Securement Deficiencies.

Severity Levels:

Low - Any of the following defects:

1. Membrane tension caused by warping or bowing of substrate.
2. Uneven joints or gaps more than ½ in. wide, but less than 2 in. between insulation boards.

Medium - Any of the following defects:

1. Uneven joints or gaps more than 2 in. wide between insulation boards or absence of substrate support for width of 2 in. or more.
2. For ballasted systems, insulation boards have been displaced.
3. Lumps indicating presence of foreign material between membrane and substrate.

Measurement:

1. Measure square feet of membrane having the above conditions.
2. When many of these deficiencies are present, the representative sampling technique may be used.

Density: $\frac{A}{B}$ *x 100* = Problem Density

Where: A = total area of membrane support distress (ft)
B = total area of roof section being rated (sq ft).

(SP) Patching

Description: Patching is a localized temporary or permanent repair of the membrane using dissimilar materials. Repairs made with similar materials are not counted as patches; distresses associated with these repairs should be recorded in the appropriate category and not as patching distresses.

Severity Levels:

Low - All patches that are not made with similar materials as that of the original construction are rated as low severity as a minumum.

Medium - All patches made with temporary materials (i.e., duct tape, caulkings, and sealants) are rated medium severity as a minimum.

High - Other distresses of high severity are present within the patched area (count as patching distress only).

Measurement:

1. Measure square feet of each patch having the above conditions.
2. When large quantities of this problem are present, the representative sampling technique may be used.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of patching (sq ft)
B = total area of roof section being rated (sq ft)

(SP) Debris and Vegetation

Description: Debris and vegetation includes the presence of foreign objects, vegitation, fungal growth, solvents, oils, or other chemicals that could damage, puncture, or degrade the membrane.

Note: Accumulation of oils and grease can present a significant fire hazard and should be reported immediately.
Note: Do not rip out vegitation that is growig into the waterproofing systems, as that may allow water to penetrate.

Severity Levels:

Medium - Any of the following defects:

1. Vegitation that has not penetrated the membrane.
2. Degradation of the membrane caused by solvents, oil, or other chemicals.
3. Foreign materials that are not removed from the roof during the inspection.

High - Any of the following defects:

1. Vegitation that has penetrated the membrane.
2. Degredation of the membrane caused by solvent, oils, or other chemicals allowing water to penetrate.

Measurement: Measure square feet of debris and vegitation having the above conditions.

Density: $\frac{A}{B} \text{ x } 100 = \text{Problem Density}$

Where: A = total area of debris and vegitaiton (sq ft)
B = total area of roof section being rated (sq ft)

(SP) Improper Equipment Supports

Definition: Improper equipment supports or pipes, conduits, and mechanical equipment supports (wood sleepers, channels, etc) that are placed directly on the membrane below the equipment. Repairing this distress may require replacing the surrounding insulation and membrane.

Severity Levels:

Low - All improper equipment supports are rated low severity as a minimum due to the maintenance problems associated with them.

Medium - Any of the following defects:
1. Movement of the support has displaced the membrane, but has not cut or punctured it.
2. Equipment is bolted through the membrane but the membrane is sealed and watertight.

High - Any of the following defects:
1. Movement of the support has cut or punctured the roof membrane.
2. The equipment is bolted through the membrane and the membrane is not sealed, allowing water to penetrate.

Measurement: Measure square feet of each improper equipment support. The minumum dimensions for the length and width of a support shall be 1 ft.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of improper equipment supports (sq ft)
B = total area of roof section being rated (sq ft)

(SP) Ponding

Definition: Ponding includes standing water or evidence of standing water by the presence of staining or accumulation of debris. Water that remains longer than 48 hr is considered ponded water.

Severity Levels:

Low - General Ponding is rated low severity.

Medium - Any of the following defects:

1. Ponding caused by wrinkles or folds in the membrane that blocks drainage.
2. Ponding caused by warping or bowing of the substrate beneath the membrane.

Measurement: Measure square feet of affected area.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of ponding (sq ft)
B = total area of roof section being rated (sq ft)

APPENDIX D – SHINGLE ROOFING DISTRESS SURVEY DEFINITIONS

General Notes

1) These definitions are applicable to shingled roofing surfaces and flashing components.

2) Where multiple severity levels are present for a given distress record each separately.

3) Distress quantities or distress density may be recorded. If distress quantities are recorded, density ranges will be computed in BUILDER/BRED. If distress densities are recorded, distress quantities will be blank in BUILDER/BRED.

4) If during the course of the inspection additional occurrences are found of distress-severity combinations, adjust the quantity or density as necessary.

5) To estimate density when distress quantities are not recorded, follow the density definitions for the individual distresses. However, for use in BUILDER, density may be estimated since density ranges are used, not the precise density value. Generalized visual cues are offered below in Table D1, but may not be applicable for certain distresses.

Table D1. Distress Density Estimation Visual Cues

Density (%)	Visual Cue (when applicable)
>0-0.1%	Difficult to notice even by careful observation, especially if spotty. (up to about 1”x 12” in a 8’x 10’ area; ⅛” in 10’ length)
>0.1-1%	Somewhat noticeable, but easily missed by casual observation, especially if spotty; Careful observation usually needed, if spotty. (up to about 10”x 12” in a 8’x 10’ area; 1¼” in 10’ length)
>1-5%	Noticeable, even by casual observation, but still only a mere fraction. (up to about 1’x 4’ in a 8’x 10’ area; 6” in 10’ length)
>5-10%	Easily noticeable even if spotty; more than a mere fraction. (up to about 1’x 8’ in a 8’x 10’ area; 1’ in 10’ length)
>10-25%	Readily noticeable, but less than ¼ of area or length.
>25-50%	Very noticeable, but less than ½ of area or length.
>50-<100%	Overwhelmingly noticeable; greater than ½ of area or length.
100%	Entire area or length.

6) These distress definitions are reproduced from ROOFER: Steep Roofing Inventory Procedures and Inspection and Distress Manual for Asphalt Shingle Roofs, CERL Technical Report 99/100 by David M. Bailey.

Distress Summary Listing

1. (SR) Step Flashing
2. (SR) Metal Cap Flashing
3. (SR) Edge Metal
4. (SR) Valley Flashing
5. (SR) Ridge/Hip Shingles
6. (SR) Metal Apron Flashing
7. (SR) Flashed Penetrations
8. (SR) Ridge/Hip Vents
9. (SR) Pitch Pans
10. (SR) Interior Gutters
11. (SR) Age Deterioration
12. (SR) Holes/Splits/Missing Shingles
13. (SR) Unsealed/Unlocked Tabs
14. (SR) Lumps/Ridges/Sags
15. (SR) Exposed Fasteners
16. (SR) Stains/Rust/Fungus/Mildew
17. (SR) Debris and Vegetation
18. (SR) Patching
19. (SR) Improper Equipment Supports

(SR) Step Flashing

Definition: Individual pieces of metal flashing material used to flash vertical walls, chimneys, dormers, and other projections. The pieces range from 7 to 10 in. long and have a 90-degree bend with a horizontal and a vertical leg. The pieces are individually placed at the end of each course of shingles where the roof meets a vertical surface. They are overlapped and "stepped up" the slope, and are fastened through the horizontal surface to the deck. Step flashing should be used only to flash a vertical surface that runs up a slope, and not across the slope.

Severity Levels:

Low - Any of the following defects:

1. Loss of protective coating or corrosion of step flashing.
2. Overlayed roof system shingles are not step flashed.
3. Coverages of less than one step flashing unit per shingle course exists.

Medium - Any of the following defects:

1. Vertical leg of step flashing is less than in. high.
2. Bent, deformed, or wide gaps in vertical leg of step flashing.
3. Loose or displaced step flashing
4. Vertical joints between step flashing pieces have been sealed closed.
5. Continuous "L" flasing exists instead of incremental step flashing.

High - Any of the following defects:

1. Holes exists in the step flashing.
2. No vertical flashing exists.
3. Top edge of step flashing is exposed, allowing water to penetrate behind flashing.

Measurement: Measure length (ft) of step flashing having the conditions described above. Individual defects count as 1 ft minimum. If the distance between distresses is less than 1 ft, count the distresses as one.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = length of step flashing defects (ft)
B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Metal Cap Flashing

Definition: Metal cap flashing includes counterflashing and any sheet metal coping cap that serves as part of the counterflashing or cover over a detail such as roof area divider, equipment curb, expansion joint, step flashing, ridge, or hip. Metal cap flashing protects the top termination of the vertical flashing (step flashing or metal apron flashing) and sheds waters away from it. It should be free to expand and contract. Properly lapped exterior siding or cladding can perform the function of metal cap flashing.

Severity Levels:

Low - Any of the following defects:

1. Loss of protective coating or corrosion.
2. Metal coping cap is deformed, allowing water to pond on the top.
3. Counterflashing is deformed but still functioning.
4. Counterflashing has been sealed to the step flashing.
5. Exposed fasteners on horizontal surfaces of metal cap flashing.

Medium - Any of the following defects:

1. Corrosion holes are present in the metal on a vertical surface.
2. Metal coping cap has loose fasteners, failure of soldered or sealed joints, open joints, or loss of attachment.

High - Any of the following defects:

1. Metal coping cap or counter flashing was not installed, or is missing or displaced from its original position, allowing water to channel behind it.
2. Corrosion holes are present in the metal on a horizontal surface.
3. Metal coping cap has missing joint covers (where originally installed).
4. Sealant at reglet or top of counterflashing is missing or no longer functioning, allowing water to channel behind counterflashing.
5. Counterflashing, exterior siding, or cladding does not extend over the top of the step flashing or apron flashing.

Measurement: Measure length (ft) of metal cap flashing having the conditions described above. Individual defects count as 1 ft minimum. If the distance between distresses is less than 1 ft, count the distresses as one.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = length of metal cap flashing defects (ft)
B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Edge Metal

Definition: Formed edge of metal, often reffered to as drip edge, placed along eaves and rakes and covered by shingles. The edge metal allows water to drip way from the verticalsurfaces and protects underlying building components.

Note: In some cases edge metal may not have been installed. If no edge metal exists for the roof section and there is no evidence that the edge metal was originally installed, do not count its absences as a distress.

Severity Levels:

Medium - Missing or displaced section of dege metal (where originally installed).

Measurement: Measure length (ft) of edge metal flashing having the conditions described above. Individual defects count as 1 ft minimum. If the distance between distresses is less than 1 ft, count the distresses as one.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = length of edge metal defects (ft)
B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Valley Flashing

Definition: Roof valley flashings are formed when two sloping sections intersect to form a "V". Water from both sections of roof runs through the valley making it especially vulerable to deterioration and leakage. Valley flashings for asphalt shingles may be of three types: (1) open valleys lined with sheet metal or mineral-surfaced asphalt roll (composition) material, (2) closed cut valleys having shingles on one side of the valley cut on an angle parallel with the valley, and (3) woven valleys lined with interwoven asphalt shingles form the adjoining roof sections. All three types of valley flashings should have underlying asphalt roll material.

Severity Levels:

Low - Any of the following defects:

1. Loss of protective coating or corrosion on metal open valley flashing.
2. No fabricated "V" crimp (vertical ridge) in center of metal open valley flashing.

Medium - Any of the following defects:

1. Loss of surfacing with exposure of felts in valley flashing.
2. Unsealed laps in open composition valley flashing.
3. Holes, splits, or cracks in valley flashing not extending down to the unerlayment.
4. Loose or missing valley shingles with no underlayment or substrate exposed.
5. Edges of valley shingles are sealed (in open or closed valleys).
6. Exposed fasteners within 12 in. of centerline of closed or woven valley.

High - Any of the following defects:

1. Holes or splits in valley flashing with underlayment or substrate exposed.
2. Loose or missing valley shingles with underlayment or substrate exposed.
3. Exposed fastener within 12 in. of centerline of open valley.

Measurement: Measure length (ft) of valley flashing having the conditions described above. Individual defects count as 1 ft minimum. If the distance between distresses is less than 1 ft, count the distresses as one.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = length of valley flashing defects (ft)

B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Ridge/Hip Shingles

Definition: Portions of shingles (usually one tab width) that are cut from a full 3-tab shingle and laid perpendicular to the hip or ridge, providing a finished watershedding cap. Note: Ridge and Hip Shingles are treated as flashings because they provide protection of the roofing system at the termination of adjoining roof planes.

Severity Levels:

Medium - Any of the following defects:

1. Holes, splits, or cracks not extending down to the underlayment or substrate.
2. Misaligned shingle resulting in partial loss of coverage but no exposed underlayment or substrate.
3. Missing shingle, but no exposed underlayment or substrate.
4. Exposed fasteners that has not backed out.

High - Any of the following defects:

1. Holes or splits that extend down to the underlayment or substrate.
2. Misaligned shingle resulting in exposed underlayment or substrate.
3. Missing shingle resulting in exposed underlayment or substrate.
4. Exposed fastened that has backed out.

Measurement: Measure lineal feet of exposure of ridge or hip shingle tabs having the conditions described above. Round total quantity to next higher whole foot. Individual defects count as 1 ft minimum. If the distance between distresses is less than 1 ft, count the distresses as one.

Density:

$$\frac{A}{B} \text{ x } 100 = \text{Problem Density}$$

Where: A = length of ridge or hip shingles having defects (ft)
B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Metal Apron Flashing

Definition: Roof-to-wall sheet metal flashing used at the upslope and downslope sides of chimneys, dormers, curbs, and other projections. Apron flashing should be placed at the downslope side of the projection with the edge of the deck flange exposed. The metal apron at the upslope side of the projection should have the edge of the deck flange covered by overlaying shingles. A projection that is wider than 2 ft should have a saddle-shaped cricket that diverts water around the projection.

Severity Levels:

Low - Any of the following defects:

1. Loss of protective coating or corrosion.
2. Vertical height is less than 4 in. high.

Medium - Any of the following defects:

1. Adsence of cricket on upslope side of penetration that is wider than 2 ft.
2. Exposed fastener in flashing.

High - Any of the following defects:

1. Edge of deck flange on upslope side of penetration is exposed or visible.
2. Edge of deck flange on downslope side of penetration is not overlapping shingles or is sealed to underlying shingles.
3. Holes, splits, or cracks in metal flashing.
4. Metal flashing is open at vertical corner.
5. No apron flashing exists.

Measurement: Measure length (ft) of metal apron flashing having the conditions described above. Individual defects count as 1 ft minimum. If the distance between distresses is less than 1 ft, count the distresses as one.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = length of flashing defects (ft)

B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Flashed Penetrations

Definition: Flashing for open pipes, plumbing vent stacks, attic vents, flues, ducts, continuous pipes, guy wires, and other roof penetrations that require a deck flange integrated into the shingles.

Severity Levels:

Low - Any of the following defects:

1. Loss of protective coating or corrosion
2. Flashing sleeve is deformed.
3. Top of flue is less than 5 in. above the roof surface on the upslope side.

Medium - Any of the following defects:

1. Exposed fastener in flashing.
2. The sleeve or umbrella is open or no umbrella is present (where required).

High - Any of the following defects:

1. Edge of deck flange on upslope side of penetration is exposed or visible.
2. Edge of deck flange on downslope side of penetration is not overlapping shingles or is sealed to underlying shingles.
3. Top of flashing sleeve is not sealed or has not been rolled down into existing plumbing vent stack.
4. Flashing sleeve is cracked, broken, or corroded through.
5. No flashing sleeve is present.

Measurement: Count each distressesed flashed penetration as 1 ft at the highest severity level present.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = length of flashed penetrations defects (ft)
B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Ridge/Hip Vents

Definition: Any device installed on and along the roof ridge or hip for the purpose of ventilating the underside of the roof deck.

Severity Levels:

Medium - Missing component of vent assembly (i.e., end caps, baffles, etc.).

High - Any of the following defects:
1. Missing or loose section of ridge or hip vent.
2. Holes, splits, or cracks n ridge or hip vent.
3. Missing cap shingle on roof vent.

Measurement: Measure length (ft) of ridge/hip vent flashing having the conditions described above. Individual defects count as 1 ft minimum. If the distance between distresses is less than 1 ft, count the distresses as one.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = length of ridge/hip vent flashing defects (ft)
B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Pitch Pans

Definition: A pitch pan is a flanged sleeve with an open bottom that is placed around a roof penetration and filled with a bituminous, polymeric, or grout sealant to seal the area around the penetration.

Severity Levels:

Medium - Top rim of pitch pan is not level on all sides.

High - Any of the following defects:

1. Holes, splits, or cracks in metal.
2. Sealing material is below metal rim.
3. Sealing material has cracked or separated from pan or penetration.
4. Edge of deck flange on upslope side of penetration is exposed.
5. Edge of deck flange on downslope side of penetration is not overlapping shingles or is sealed to underlying shingles.

Measurement: Count each distressed pitch pan once at the highest severity level present.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = number of distressed pitch pans (ft)
B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Interior Gutters

Definition: An interior gutter is a built-in trough of metal or other material that collects water from the roof and carries it to a drain or downspout.

Severity Levels:

Low - Entire length of interior gutter is rated low severity, as a minimum, due to the maintenance problems and high potential for leak damage associated with its presence.

High - Any of the following defects:

1. Clogged gutter or drain.
2. Holes or open seams in interior gutter.

Measurement: Measure entire length of gutter having the conditions described above. For clogged gutters, count lineal feet of clogging material. For clogged drain, count as 1 ft. Individual defects count as 1 ft minimum. If the distance between distresses is less than 1 ft, count the distresses as one.

Density:

$$\frac{A}{B} \text{ x } 100 = \text{Problem Density}$$

Where: A = length of gutter defects (ft)
B = total length of flashing on roof section being rated (including periemter flashings such as flashing, edge metal, ridge and hip shingles, and valley flashings; and curb flashings around large penetrations such as dormers and skylights).

(SR) Age Deterioration

Definition: Age deterioration includes clawing and curling of the shingles, and exposure of the shingle felt/mat due to excessive loss of granules, all of which indicate brittleness. Normally, these are not localized problems but are general conditions found on large areas of the roof, such as individual roof exposures, or the entire roof. The occurance of these problems indicate aging and reduced service life. Clawing is the turning under of the tab corners of the shingle and curling is the turning up of the tab corners.

Severity Levels:

Low - Any of the following defects:

1. Loss of granular surfacing on shingle, but the reinforcement felt or mat is not exposed.
2. Erosion of material around the edge of the shingle, normally found less than 1/4 inch from the edge.

Medium - Any of the following defects:

1. Corners of the shingle are turned under or up (that is, clawing or curling).
2. Loss of granular surfacing on shingle that results in bare spots and exposes reinforcing felt or mat.
3. Loss of delamination of loil on loil-surfaced shingle.

Measurement: Measure the exposed area (sq ft) of shingles having the above conditions.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total exposed area of shingles (sq ft) having age deterioration defects.
B = total area of roof section being rated (sq ft).

(SR) Holes/Splits/Missing Shingles

Definition: This category of distresses is characterized by holes, splits, cracks, or visible tears in the shingle reinforcing felt or mat, or missing shingles or tabs.

Severity Levels:

Medium - Any of the following defects:

1. Holes, splits, or cracks that do not extend down to the underlayment or substrate.
2. Misaligned shingle resulting in partial loss of coverage but no exposed underlayment or substrate.
3. Missing shingle, but no exposed underlayment or substrate.

High - Any of the following defects:

1. Holes or splits that extend down to the underlayment or substrate.
2. Misaligned shingle, resulting in exposed underlayment or substrate.
3. Missing shingle, resulting in exposed underlayment or substrate.
4. Exposed fastener that has backed out. (Note: if fastener has not backed out, count as exposed fastener distress, not a hole).

Measurement: Measure the exposed area (sq ft) of shingles having the above conditions.

Density:

$$\frac{A}{B} \text{ x } 100 = \text{Problem Density}$$

Where: A = total exposed area of shingles (sq ft) having holes/splits/missing shingle defects.
B = total area of roof section being rated (sq ft).

(SR) Unsealed/Unlocked Tab

Definition: For a seal-down shingle, a lack of adhesion between the tab of a shingle and underlying shingles indicates an unsealed condition. Displacement or damage to a lock-down shingle that results in the loss of its interlocking mechanism indicates an unlocked condition.

Note: For seal-down shingles, use a trowel or fingers and gently try to lift tab. Any adherence of the shinge tab to underlying shingles should be judged as adequate. Test several adjacent shingles in three or four randomly selected areas of the roof. If any shingles are found to be unsealed, use the ampling method to determine the quantitiy of the affected area.

Severity Levels:

Medium - Any of the following defects:

1. The tab of a shingle, that is designed to be sealed down is unsealed.
2. A lock-down shingle is not interlocked.

Measurement: Measure the exposed area (sq ft) of shingles having the above conditions.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total exposed area of shingles (sq ft) unsealed/unlocked defects.
B = total area of roof section being rated (sq ft).

(SR) Lumps/Ridges/Sags

Definition: Lumps, ridges, or sags are present on the surface of the roof.

Note: If other problems exist in the areas that exhibit lumbing, sagging, or ridging, record them under the appropriate distresses.

Severity Levels:

Medium - Any of the following defects:

1. Lumps or ridges that do not appear to be caused by unevenness in the supporting substrate or underlying flashing component (i.e., wrinkles in the underlying felt).
2. Lumps, ridges, or sags caused by unevenness in the supporting substrate or underlying flashing component.

Measurement: Measure the exposed area (sq ft) of shingles having the above conditions.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total exposed area of shingles (sq ft) having lumps/ridges/sages defects.
B = total area of roof section being rated (sq ft).

(SR) Exposed Fasteners

Definition: Shingle fasteners are visible in the field of the roof.

Note: If a shingle fastener has backed out , count it as a hole.

Severity Levels:

Medium - A fastener is exposed but not backed out.

Measurement: Measure the number of exposed fasteners. Individual exposed fasteners count as 1 sq ft minimum. If more than one exposed fastener is found in an area of 1 sq ft, count the distressed area as 1 sq ft.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of exposed fasteners (sq ft) having defects.
B = total area of roof section being rated (sq ft).

(SR) Stains/Rust/Fungus/Mildew

Definition: The shingle surface shows evidence of stains, rust, fungus, or mildew.

Note: If the appearance is unacceptable, corrective treatments can be applied, such as cleaning with trisodium hypochlorate or installing zine strips.

Severity Levels:

Low - Evidence of stains, rust, fungus, or mildew.

Measurement: Measure the exposed area (sq ft) of shingles having the above conditions.

Density: $\frac{A}{B} \times 100 =$ Problem Density

Where: A = total exposed area of shingles (sq ft) having stains/rust/fungus/mildew defects.
B = total area of roof section being rated (sq ft).

(SR) Debris and Vegetation

Definition: This category includes any of the following items:

- Foreign objects on the roof that could casue damage or puncture the shingles or flashing.
- The growth of vegetation on the roof.
- Accumulation of solvent or oil drippings on the roof.

Severity Levels:

Medium - Any of the following defects:

1. Collection of foreign objects or vegitation on the field of the roof.
2. Grease, solvent, or oil drippings on the roof but no apparent degradation or the roofing system.
3. Evidence of branches making contact with the roof shingles.

High - Any of the following defects:

1. Grease, solvent, or oil drippings on the roof that have caused degradation of the roofing shingles.
2. Vegetation roots that have penetrated the roof shingles.

Measurement: Measure the exposed area (sq ft) of shingles having the above conditions.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total exposed area of shingles (sq ft) debris and vegitation defects.
B = total area of roof section being rated (sq ft).

(SR) Patching

Definition: Roof repairs were previously made using dissimilar materials such as mastics or shingles of a different color or design.

Severity Levels:

Low - Replacement shingle does not match appearance or composition of original adjacent shingles.

Medium - Shingle replacement patch is composed of dissimilar materials such as mastic, roofing felts, or coatings.

High - Shingle replacement patch composed of dissimilar materials, that have other high severity distresses (i.e., holes, splits, and cracks).

Measurement: Measure the exposed area (sq ft) of shingles having the above conditions.

Density: $\frac{A}{B} \times 100 =$ Problem Density

Where: A = total exposed area of shingles (sq ft) having patching defects.
B = total area of roof section being rated (sq ft).

(SR) Improper Equipment Supports

Definition: This distress category includes pipe, conduit, and mechnical equipment supports (wood sleepers, channels, etc.) that are placed directly on the roof surface with no protective pad or placed at an insufficient height to allow for maintening the roofing system belwoe the equipment. Repairing this type of distress may require replacing the surrounding roofing system.

Note: Termination for guy wires are to be rated as flashed penetration distresse.

Severity Levels:

Medium - The equipment is bolted through the shingles and the bolts appear to be sealed.

High - Any of the following defects:

1. The support has caused movement or damage to the shingles.
2. The equipment is bolted through the shingles and the bolts do not appear to be sealed.

Measurement: Measure square feet of each improper equipment support. The minimum dimension for length and width of a support shall be 1 foot.

Density: $\frac{A}{B}$ x 100 = Problem Density

Where: A = total area of improper equipment supports (sq ft).
B = total area of roof section being rated (sq ft).

APPENDIX E - DIRECT CONDITION RATING DEFINITIONS

Rating	SRM Needs	Rating Definition
Green (+)	Sustainment consisting of possible preventive maintenance (where applicable).	Entire component-section or component-section sample free of observable or known distress.
Green	Sustainment consisting of possible preventive maintenance (where applicable) and minor repairs (corrective maintenance) to possibly few or some subcomponents.	No component-section or sample serviceability or reliability reduction. Some, but not all, minor (non-critical) subcomponents may suffer from slight degradation or few major (critical) subcomponents may suffer from slight degradation.
Green (-)		Slight or no serviceability or reliability reduction overall to the component-section or sample. Some, but not all, minor (non-critical) subcomponents may suffer from minor degradation or more than one major (critical) subcomponent may suffer from slight degradation.
Amber (+)	Sustainment or restoration to any of the following: Minor repairs to several subcomponents; or Significant repair, rehabilitation, or replacement of one or more subcomponents, but not enough to encompass the component-section as a whole; or Combinations thereof.	Component-section or sample serviceability or reliability is degraded, but adequate. A very few, major (critical) subcomponents may suffer from moderate deterioration with perhaps a few minor (non-critical) subcomponents suffering from severe deterioration.
Amber		Component-section or sample serviceability or reliability is definitely impaired. Some, but not a majority, major (critical) subcomponents may suffer from moderate deterioration with perhaps many minor (non-critical) subcomponents suffering from severe deterioration.
Amber (-)		Component-section or sample has significant serviceability or reliability loss. Most subcomponents may suffer from moderate degradation or a few major (critical) subcomponents may suffer from severe degradation.
Red (+)	Sustainment or restoration required consisting of major repair, rehabilitation, or replacement to the component-section as a whole.	Significant serviceability or reliability reduction in component–section or sample. A majority of subcomponents are severely degraded and others may have varying degrees of degradation.
Red		Severe serviceability or reliability reduction to the component-section or sample such that it is barely able to perform. Most subcomponents are severely degraded.
Red (-)		Overall component-section degradation is total. Few, if any, subcomponents salvageable. Complete loss of component-section or sample serviceability.

APPENDIX F – PAINT/COATING RATING DEFINITIONS

Rating	**% Deteriorated**	**Relative Amount Deteriorated**
Green (+)	0.00 – 0.03	Up to about 1”x 4” in a 8’x 10’ area; 1/32” in a 10’ length; or 3 in 10,000
Green	0.03 – 0.10	Between about 1”x 4” and 1”x 12” in a 8’x 10’ area; 1/32” and ⅛” in a 10’ length; or 3 and 10 in 10,000
Green (-)	0.10 – 0.30	Between 1”x 12” and 3”x 12” in a 8’x 10’ area; ⅛” and ⅜” in a 10’ length, or 1 and 3 in 1000
Amber (+)	0.30 – 1.00	Between 3”x 12” and 10”x 12” in a 8’x 10’ area; ⅜” and 1¼” in a 10’ length; or 3 and 10 in 1000
Amber	1.00 – 3.00	Between 10”x 12” and 18”x 18” in a 8’x 10’ area; 1¼” and 3¾” in a 10’ length; or 1 and 3 in 100
Amber (-)	3.00 – 10.0	Between 1’x 2½’ and 1’x 8’ in a 8’x 10’ area; 3¾” and 12” in a 10’ length; or 3 and 10 in 100
Red (+)	10.0 – 17.0	Between 1’x 8’ and 1¾’x 8’ in a 8’x 10’ area; 1’ and 1¾’in a 10’ length; or 10 and 17 in 100
Red	17.0 – 33.0	Between 1¾’x 8’ and 3⅓’x 8’ in a 8’x 10’ area; 1¾’ and 3⅓’ in a 10’ length; or 17 and 33 in 100
Red (-)	33.0 - 100	Greater than 1/3 of area, length, or amount